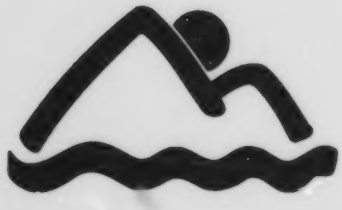
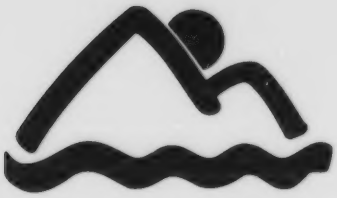
BC Environment

A Strategic Analysis of Waste Plastics Reprocessing in British Columbia



British Columbia
Handle with care



British Columbia
Handle with care

A Strategic Analysis of Waste Plastics Reprocessing in British Columbia

Municipal Solid and
Biomedical Waste Branch
Environmental Protection Division
B.C. Environment

July 1991

Prepared by:
Peat Marwick Stevenson & Kellogg

Printed on recycled paper

92-01353/

Foreward

The Municipal Solid and Biomedical Waste Branch of the Ministry of Environment is charged with the implementation of the Municipal Solid Waste Management Strategy of the Provincial Government. This Branch coordinates the various efforts of government, the public, industry and business as they work together toward the provincial goal of 50% per capita solid waste reduction by the year 2000.

One initiative undertaken by the Branch in addressing this goal is the commissioning of studies to evaluate existing markets for recyclable materials, and to identify ways to expand recycling activities in the Province.

In February, 1991, Peat Marwick Stevenson & Kellogg was retained to conduct a study of waste plastics reprocessing in British Columbia. The study was completed and approved for release in August, 1991. While many stakeholders were involved during the preparation of this report, it is recognized that new information will come to light. All stakeholders are invited to submit their comments and recommendations for improvements to the Manager, Marketing & Enterprise development, Municipal Solid and Biomedical Waste Branch.

R. J. Driedger, P. Eng.
Director, Municipal Solid
and Biomedical Waste Branch

Contents

I Introduction 1

A. Background 1

B. Purpose and objectives 1

C. Study methods 2

II Highlights 3

A. Generation and recovery of waste plastics 3

B. Collection and transportation of waste plastics 4

C. The waste plastics reprocessing industry 5

D. Markets for waste plastics 6

E. A scenario for the year 2000 6

F. Policy recommendations 7

III Generation And Recovery Of Waste Plastics 9

A. British Columbia generates 250,000 tonnes of plastic waste annually 9

B. Plastics can be classified into four groups 11

C. HDPE and LDPE are the primary waste plastics generated 11

D. About 3% of British Columbia's waste plastics are recovered 13

E. HDPE is the primary waste plastic recovered 14

F. Waste plastics follow common pathways 15

G. Some forms of plastics recycling are preferred over others 17

Contents *(Cont'd)*

H. Barriers to increased plastics recycling exist 18

IV Collection And Transportation Of Waste Plastics 20

A. Recyclable waste plastics are collected in four primary ways 20

B. Curbside programs—a growing number accept waste plastics 21

C. Depots—less convenient but more widely available 23

D. Buy-back programs—strong possibility of expansion 24

E. Self-haul—many niches for private sector firms 24

F. Mixed waste is not recyclable 25

V The Waste Plastics Reprocessing Industry 26

A. The waste plastics reprocessing industry in British Columbia comprises 19 firms 26

B. Brokers are primarily exporters of waste plastic 27

C. The processing industry is in its infancy 29

D. Eight British Columbia plastic products manufacturers use recycled resins 32

E. Putting it all together—what happens to B.C.'s recovered plastic waste 32

F. Some recyclable plastics are not being processed 34

G. Potential new entrants are interested in the processing and manufacturing levels of the industry 34

H. Some collected waste plastic may be going to landfill 35

Contents *(Cont'd)*

VI Markets For Waste Plastics 36

A. Two markets exist—one for recycled single resins, another for recycled comingled resins 36

B. Strong local markets exist for recycled single resins 36

C. Markets are more developed for some recycled single resins than for others 38

D. Waste plastics processors in Alberta and Washington State can be considered customers and competitors 39

E. Recycled single resins compete directly with virgin resins 40

F. Markets for comingled plastic resins are undeveloped 42

VII A Scenario For The Year 2000 44

A. British Columbians will use 420,000 tonnes of plastics annually 44

B. With existing and announced initiatives, 27,000 tonnes could be collected annually 45

C. With existing initiatives, growth in the reprocessing industry is expected to at least match available waste supply 49

D. The British Columbia plastics industry could absorb 18,000 tonnes of single resin and 25,000 tonnes of comingled waste plastics, annually 50

VIII Policy Recommendations 53

A. Policy should focus on the collection infrastructure and processing levels of the industry 53

B. The collection infrastructure needs to expand and change 54

Contents (Cont'd)

C. Policy supporting the waste plastics reprocessing industry should focus on processors 55

D. Policies affecting markets 56

E. Other 57

Bibliography 59

Appendices

A. Glossary Of Terms

B. Interview Guide For Processors Of Recyclable Plastics

C. List Of Interviewees

D. Plastics Waste Composition Statistics For British Columbia And Other Jurisdictions

E. Plastic Resin Codes

I

Introduction

A. Background

In late 1989, the Cabinet of the Provincial Government endorsed a Ministry of Environment plan to reduce municipal solid waste (MSW) 50% per capita by the year 2000 in British Columbia. The goal is to be achieved through a combination of source reduction, reuse, and recycling measures. The Municipal Solid and Biomedical Waste Branch of the Ministry of Environment has commissioned a number of studies to evaluate existing markets for recyclable materials and identify ways to expand reprocessing activities in the province. The Branch has also implemented a variety of programs and incentive schemes recommended in those studies.

While recycling is well established for some types of materials, it is poorly developed for others. One material type for which the markets and supporting infrastructure are not well developed, is waste plastics. As a result, in February 1991, the Branch retained Peat Marwick Stevenson & Kellogg to conduct a study of waste plastics reprocessing in British Columbia.

B. Purpose and objectives

The general purpose of the study was to determine why the waste plastics industry is not well developed, both in terms of supply of waste plastics for reprocessing and demand for recycled plastic products. The specific objectives of the study were to:

- Determine the potential to expand the infrastructure, processing capabilities, and markets for recyclable plastics in the province.
- Identify barriers and opportunities to expand waste plastics reprocessing in British Columbia, including suggestions to capitalize on the opportunities and overcome the barriers.
- Recommend the types of plastics reprocessing projects that the provincial government should support.
- Recommend options to landfill disposal of waste plastics that cannot be economically recycled or reprocessed.

C. Study methods

Because of the relatively small amount of current written material on waste plastics reprocessing in British Columbia, we relied primarily on interviews with recycling industry representatives to obtain our information. We also interviewed government officials, industry association directors, and plastics research organizations.

We estimated the volumes of plastics waste generated from waste composition studies conducted in British Columbia and other nearby jurisdictions. We also used virgin plastic production estimates to determine our waste generation figures. We based our assumptions of the recyclable portion of plastic on industry association reports. Because of the wide variety of plastic types and the even greater number of uses, it was very difficult to develop reliable estimates. As such, the figures presented in this report are intended only to provide "ball-park" estimates, suitable to making broad policy decisions.

A glossary of terms is presented in Appendix A. Our interview guide for industry representatives is provided in Appendix B. A list of the individuals that we interviewed is provided in Appendix C.

II

Highlights

As part of the British Columbia government's plan to reduce municipal solid waste (MSW) 50% per capita by the year 2000, Peat Marwick Stevenson & Kellogg was retained to conduct a study of waste plastics reprocessing in British Columbia. The general purpose of the study was to describe the collection infrastructure, processing capabilities, and markets for recyclable waste plastics in the province and to recommend ways for the Ministry of Environment to help expand the waste plastics reprocessing industry.

A. Generation and recovery of waste plastics

British Columbia is expected to generate about 250,000 tonnes of plastic waste in 1991. This assumes that plastic represents 10% of total MSW and that the average per capita waste generation is 775 kilograms per year. About half of the plastic waste generated come from residential sources while the other half comes from industrial/commercial/ institutional (ICI) sources. Plastics can be classified into four major groups:

commodity thermoplastics
engineering thermoplastics
thermosets
multi-material plastics and laminations.

We restricted our analysis primarily to commodity thermoplastics because they have the greatest recycling potential. The major types of commodity thermoplastics include:

high density polyethylene (HDPE)
low density polyethylene (LDPE)
polyethylene terephthalate (PET)
polypropylene (PP)
polyvinyl chloride (PVC)
polystyrene (PS)
acrylonitrile-butadiene-styrene (ABS).

About 3% (7,000 tonnes) of the waste plastics generated in British Columbia are recovered for recycling from the MSW stream. The two major types of waste plastics recovered are HDPE and PET. About 2,600 tonnes of HDPE are recovered, representing about 7% of total HDPE generated. A slightly smaller amount of PET is recovered

(2,200 tonnes). However, because PET is covered by deposit legislation, the recovery rate is about 88% of total PET waste generated.

Each major type of plastic generally follows the same waste pathway. Waste plastics are generated at two stages in the plastics lifecycle: at the pre-consumer stage and at the post-consumer stage. Post-consumer plastic represents the plastic consumed by residential and commercial users that becomes part of the municipal solid waste stream. Pre-consumer or manufacturing plastic waste represents the scrap left over from plastics manufacturing and fabrication operations. Post-consumer waste is generally contaminated and often of unknown composition while pre-consumer waste is typically clean and of known composition. Recyclable waste plastics are usually collected through curbside programs, buy-back centres, and drop-off depots or transported directly to a plastics recycling company. There are three levels of recyclers: the broker, the processor, the remanufacturer. The broker sorts, cleans, bales, and ships waste plastics to the processor. The processor then makes the material into flakes or pellets, which it ships to the remanufacturer that will use the flakes or pellets to make plastic products with recycled content.

B. Collection and transportation of waste plastics

Recyclable waste plastics in British Columbia are diverted from disposal using four primary collection methods. These include curbside pickup, drop-off, buy-back and self-haul.

Curbside pickup refers to residents of single family dwellings that put recyclable plastics in special boxes or bags to be collected at curbside by municipal crews. About 700 tonnes of waste plastics were collected from ten GVRD municipalities by this method in 1990. The curbside collection and transportation of waste plastics is generally conducted by one of the following organizations: municipalities, waste transportation companies, or waste brokers. The choice of a collector depends on the degree of source separation desired, the type of vehicles needed, the distance the material must be transported and the price charged by private sector companies.

Drop-off collection relates to recyclable plastics that are dropped off at collection bins or central depots. About 600 tonnes of waste plastics are collected through about ten depots (primarily located in the GVRD). Depots are less convenient than curbside pickup but are more widely available and provide the best means of recycling to department dwellers. Three types of depots operate in British Columbia including municipal depots, private sector depots, and not-for-profit depots.

Buy-back programs refer to recyclable plastics that are returned to retail outlets and some depots for a deposit refund. Deposits are only applied to one and two litre PET softdrink and beverage alcohol containers. Annually, about 2,000 tonnes of PET plastic waste are collected by this method.

Under self-haul collection, recyclable plastics are transported by the waste generator directly to the broker or processor. About 3,700 tonnes are collected by this method annually and almost exclusively from non-residential sources. Strong potential exists to expand self-haul arrangements between processors and ICI waste generators.

C. The waste plastics reprocessing industry

The waste plastics reprocessing industry in British Columbia is small, but growing. A total of 19 firms participate in the process of converting both pre-consumer and post-consumer plastic waste into new products. These firms fall into one of three categories:

- **Brokers**—Companies that receive plastic waste from the collection infrastructure and perform a cleaning, sorting and baling function.

- **Processors**—Firms that purchase plastic waste either from brokers or directly from waste generators, reclaim useable resins in the form of flakes or pellets, and provide these raw materials to remanufacturers.

- **Manufacturers**—Firms that use reclaimed resins to manufacture new products with recycled content. the new products are rarely 100% recycled material; most contain a mixture of reclaimed and virgin plastic resins.

As recently as three years ago, the waste plastics reprocessing industry in British Columbia comprised brokers only. Advances in reclamation technologies and growing interest in recycling in general, encouraged processors to enter the industry during the late 1980s. Today, we estimate that the annual sales of waste plastic in baled and reclaimed resin form at about $3.3 million annually in British Columbia.

Seven companies in British Columbia can be classified as brokers of waste plastics. However, four of these firms are beverage distributors that handle only PET bottles. We estimate that British Columbia's brokers handle a total of about 4,200 tonnes of plastic waste annually; almost all from post-consumer residential and ICI sources. Virtually all the waste plastic handled by the brokers is exported

Eight firms can be classified as waste plastics processors in British Columbia. However, only two are dedicated solely to processing activities. About 3,600 tonnes of waste plastics are processed in the province, representing just over half of the total waste plastics recovered.

Eight British Columbia plastics manufacturers incorporate a significant quantity of recycled resins in their products. Four of these firms are vertically integrated as plastics processors. These manufacturers use about 2,700 tonnes of plastic resins reclaimed in British Columbia. All remanufacturers interviewed state that they would use more reclaimed resin if it were available.

D. Markets for waste plastics

Two markets exist for waste plastics; one for recycled single resins and another for recycled comingled resins. Recycled single resins, made from separated waste plastic, is a substitute product for virgin resin. Thus, the demand for recycled single resin is linked directly to the demand for virgin resin.

Conversely, comingled recycled resins, made from unseparated waste plastic, are not substitutes for virgin resins. Comingled resins can be used to replace materials like treated lumber, but are not mixed with virgin resins to manufacture plastic products.

The potential demand in British Columbia for recycled single resin greatly exceeds available supply. We estimate this potential demand at 10,400 tonnes. British Columbia's processors supply manufacturers with a total of 2,700 tonnes of recycled single resin pellets, only 26% of the aforementioned potential demand. Users of virgin resins consider several factors before incorporating recycled resins in the manufacturing process. These include: the price for the recycled resin, its purity and strength, and the function of the end product. Prices for recycled single resins are directly related to prices for the virgin material. The presence of contaminants and the effects of natural degradation on recycled plastic resin can severely restrain its use in manufacturing processes. In both Canada and the United States, federal laws inhibit the use of recycled plastic in the manufacture of food containers.

Markets are limited for comingled plastic waste. While a manufacturer of plastic wood may soon be established in British Columbia, the majority of comingled waste plastic now recovered from the waste stream is shipped to Asia. Products made with recycled, comingled plastic resins are technically capable of replacing a portion of the treated lumber market. Growth appears to be constrained by the low economic value and variable quality of the comingled material. Lack of available, cost-effective processing technologies is also an inhibiting factor.

E. A scenario for the year 2000

Based on some very rough calculations, we estimate that total plastic consumption in British Columbia will increase from 250,000 tonnes in 1990 to 420,000 tonnes in the year 2000. By the year 2000, we believe it will be possible to recover 27,400 tonnes of plastics waste (up from 4,650 tonnes in 1990). A key element in increasing the volume of recovered waste plastics is to establish Materials Sorting Facilities (MSF) to accept comingled recyclable materials and separate them into their various components.

All of the participants in British Columbia's plastics reprocessing industry—brokers, processors and remanufacturers—want to expand. However, the expansion that will take place is largely dependant on how the infrastructure develops. The demand in the year 2000 for recycled single resin by British Columbia plastics manufacturers is estimated to

be 17,700 tonnes per year. Manufacturers using comingled plastics could add significantly to this total. We estimate that demand for plastic substitutes such as treated lumber to be about 25,000 tonnes per year in the year 2000.

F. Policy recommendations

Although the markets for recycled plastic resins are new and the economic viability of producing and marketing these resins is unproven, market potential for recycled single plastic resins is vast. Markets are developing quickly and more and more manufacturers are beginning to substitute recycled resins for their virgin counterparts. Lack of consistent supply of reprocessed resins is the primary impediment to increased used by manufacturers. The collection infrastructure is not recovering sufficient waste plastic to support strong growth by processors. In addition, the vast majority of post-consumer plastic waste recovered from the MSW stream is unsorted. Because British Columbia's brokers do not find it economic to sort plastic waste by resin type, most post-consumer waste recovered from MSW is suitable only for export to Asia.

Market potential for comingled plastic resins also appears large. However, these markets are also unproven, as is the economic viability of producing and marketing comingled resins in the form of plastic wood. While British Columbia's waste plastics collection infrastructure is well geared to feed operations of this type, comingled resin processing is less attractive than single resin processing.

Given the above, policy should focus on stimulating the growth of a collection infrastructure that source-separates plastic wastes and encourages the development of single resin reprocessing.

The Ministry of Environment can influence the efficiency of the waste plastics collection infrastructure both directly and indirectly. While curbside pickup is the responsibility of municipal and regional governments, the Ministry of Environment could encourage curbside pickup to be expanded to new communities and to a wider variety of plastics. It can encourage the establishment of drop-off depots in communities where curbside pickup of plastics is not feasible offer low interest loans for the purchase of balers. Concerning the proposed deposit/refund legislation, we recommend that it include milk and fruit juice beverage containers. The Ministry of Environment should also encourage the establishment of material sorting facilities to stimulate the growth of the waste plastics industry within British Columbia.

Changes and/or expansion at all levels of the reprocessing industry will be needed if waste plastics recovered from British Columbia's MSW are to be processed and recycled in the province. The Ministry can encourage brokers to sort waste plastics rather than exporting comingled waste. The Ministry could support the establishment of comingled plastics processors in regions of the province that cannot support the building of an MSF. Concerning manufacturers, the Ministry could encourage the coding of plastic containers to identify resins, encourage the industry to reduce the number of plastics used in its

products, encourage the industry to develop reuseable plastic containers, and encourage or legislate the use of water soluble inks rather than paper labels.

Although market potential for recycled plastic resins appears strong, markets are still in their infancy. The Ministry of Environment can help stimulate market growth in several ways. It can develop purchasing policies that promote the use of plastic products with recycled content. It can promote public education and awareness of the benefits of purchasing plastic products with recycled content. It can also promote research and development aimed at developing new products from recycled plastics or increasing the use of recycled resin in the manufacture of recycled products.

In other areas, the Ministry can work with adjacent jurisdictions to coordinate plastics processing activities. It can encourage consumers to reduce consumption of disposable plastic packaging and to use refillable or recyclable containers or packaging whenever possible. It can further encourage industry to take a cradle to grave responsibility for the packaging it uses.

III

Generation And Recovery Of Waste Plastics

A. British Columbia generates 250,000 tonnes of plastic waste annually

In March 1990, our firm prepared a report for the Ministry of Environment entitled, **A Market Development Plan for Recyclable Materials in British Columbia**. In that report we estimated that each British Columbian generates 800 kilograms of solid waste annually. We also estimated that about 9% of the waste stream consists of plastics.

Since that time, waste composition studies conducted by the Ministry of Environment and the Capital Regional District (CRD) reveal that the percentage of plastics in the waste stream has increased slightly. Based on their figures, we estimate that plastic now represents about 10% of total MSW across British Columbia. If we assume that source reduction and reuse efforts initiated in the last year have reduced the per capita waste generation to 775 kilograms per year (a conservative reduction of 3%) and use the projected 1991 population figure of 3,203,200 for the province, British Columbia is expected to generate about 250,000 tonnes of plastics waste in 1991.

The amount of plastics waste generated by region within British Columbia corresponds closely to population size. However, people in rural areas generated less plastic waste than urban dwellers (60 kilograms/person/year versus 90 kilograms/person/year). We estimate that Greater Vancouver Regional District (GVRD) residents and CRD residents generate about 135,000 tonnes and 30,000 tonnes of plastic waste per year, respectively.

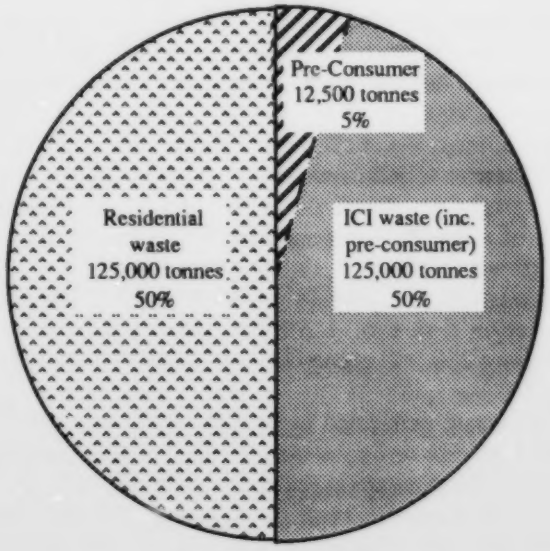
Waste composition studies in other jurisdictions suggest that about 50% of plastics wastes are residential (collected at curbside by municipal staff) and 50% are industrial/commercial/institutional (ICI) (collected by private haulers from industrial and commercial locations). Adopting these figures for the province reveals that residential sources and ICI sources each generate about 125,000 tonnes of plastics waste.

ICI waste can further be divided into two categories: post-consumer waste and pre-consumer waste (all residential waste is considered post-consumer waste). Post-consumer waste refers to plastic products or packaging that have been "consumed" by industrial or residential users. These materials have fulfilled the use for which they were intended. Conversely, pre-consumer waste refers to plastic waste that has been generated as a by-product of the manufacturing process, such as off-cuts and end products that did not meet quality control standards. A significant portion of this pre-consumer waste is

recycled within the plant that manufactures it. This waste is not relevant to this study because it has always been recycled and would never, in normal circumstances, enter the MSW stream. The remaining pre-consumer waste, however, cannot be recycled within the plant and must be sent outside the firm for recycling or disposal. As will be discussed later in the report, this pre-consumer waste is important because it is generally clean, of known composition, and easily recycled. Based on discussions with plastics industry officials, we estimate that pre-consumer plastic waste that cannot be recycled in-plant represents about 5% or 12,500 tonnes of the plastics waste generated in the province.

Exhibit III-1 summarizes the various sources of British Columbia's waste plastics.

Exhibit III-1
Sources of British Columbia's waste plastic



Source: Based on waste composition studies from B.C. and other jurisdictions, virgin plastics user figure and interviews with industry participants.

We caution that these figures are based on major assumptions. Accurate figures can only be determined from detailed waste composition studies at waste disposal sites around the province. Additional statistics on plastics waste composition are provided in Appendix D.

B. Plastics can be classified into four groups

Plastics are made from fossil fuels and a small percentage of chemical additives. The additives are very important because they give plastics their versatile and useful properties. Unfortunately, it is the additives that also make certain plastics difficult to recycle.

Four major groups of plastics are used in British Columbia, as follows:

- **Commodity thermoplastics**—Plastics produced at low cost in high volumes that are suitable for recycling. These plastics can be repeatedly softened with heat and remolded without a significant reduction in performance. They represent over two-thirds of all plastic sales. One example is polystyrene (PS). This report focuses on these plastics.

- **Engineering thermoplastics**—High cost, low volume plastics used in the construction, transportation, and electronics industries. These plastics form only a small proportion of MSW. One example is PTFE or Teflon.

- **Thermosets**—Plastics used for long-lived products such as furnishings and building insulation. These plastics are generally not recyclable because they cannot be softened and remolded, although they can be used as filler. This group represents about 20% of plastic sales. One example is polyurethane.

- **Multi-material plastics and laminations**—Combinations of different types of plastics or plastics and other materials such as paper and metal foil. These plastics are used primarily for food packaging because of their favourable properties, such as increased shelf life. These plastics are technically difficult to recycle except into plastic products made with comingled resins. One example is the aseptic drinking box (two layers of plastic, paper and foil).

In this report, we have restricted our analysis to commodity thermoplastics and, to a lesser extent, multi-material plastics. A list of the major types of thermoplastics and the products with which they are associated is presented in Exhibit III-2.

C. HDPE and LDPE are the primary waste plastics generated

A breakdown of the type and weight of waste plastics generated in British Columbia is presented in Exhibit III-3. We caution that these figures represent very approximate estimates as very little MSW field sampling has been conducted in the province. We relied primarily on plastics waste composition studies conducted in other jurisdictions and virgin plastics consumption estimated from the Canadian Plastics Institute to establish these waste generation figures.

Exhibit III-2
Major types of recyclable plastics

Type of Plastic	Associated Products/Packaging
High density polyethylene (HDPE)	Food containers Extruded pipe Oil bottles Milk/juice bottles
Low density polyethylene (LDPE)	Agricultural film Shopping bags Grocery bags
Polyethylene terephthalate (PET)	Soft drink, cooler and cider bottles
Polypropylene (PP)	Dairy product containers Battery casings
Polyvinyl chloride (PVC)	House siding Pipes Surgical gloves
Polystyrene (PS)	Fast food packaging Egg cartons Disposable plates/cups
Acrylonitrile-butadiene-styrene (ABS)	Automotive parts Electrical housings Refrigerator liners Sporting goods

Exhibit III-3
Composition of waste plastics generated in British Columbia

	Total Plastics Waste	
Type of Plastic	Tonnes (000s)	Per cent
HDPE	37	15
LDPE	60	24
PET	3	1
PP	20	8
PVC	50	20
PS	22	9
ABS	8	3
Other plastics	50	20
TOTAL	250	100

Source: Adapted from various waste composition studies and virgin plastic consumption statistics.

HDPE and LDPE appear to be the largest component of the plastics waste stream, accounting for about 39% of the total. About two thirds of this amount is LDPE while the remaining third is HDPE. This is not surprising given that polyethylene is the most predominant thermoplastic resin used in packaging. Packaging makes up more than half of total plastics waste in the MSW stream.

D. About 3% of British Columbia's waste plastics are recovered

Based on our industry survey, we estimate that British Columbia recovers about 3% (7,000 tonnes) of its waste plastics from the MSW stream. The term "recovery" is used to describe that amount of waste that is diverted from landfill or incineration. It is sometimes used synonymously with "recycling" although, technically, recycling occurs only when the waste is remanufactured into a new product. A significant quantity of waste plastics is exported from British Columbia to be recycled.

A breakdown of the type and weight of waste plastics recovered in British Columbia is provided in Exhibit III-4. These recovery rates are compared with total waste plastics generated in Exhibit III-5.

Exhibit III-4
Composition of waste plastics recovered in British Columbia

	Total Recovered Waste		Post-consumer Waste		Pre-consumer Waste	
Type of Plastic	Tonnes	Per cent	Tonnes	Per cent	Tonnes	Per cent
HDPE	2,600	37	1,100	24	1,500	64
LDPE	250	4	200	4	50	2
PET	2,200	31	2,200	47	0	–
PP	350	5	300	7	50	2
PVC	400	6	0	--	400	17
PS	50	1	0	--	50	2
ABS	300	4	0	--	300	13
Mixed	850	12	850	18	0	--
TOTAL	7,000	100	4,650	100	2,350	100

Source: Survey of industry participants, March 1990.

Exhibit III-5
Quantity of waste plastics recovered as percentage of total waste plastics generated

Type of Plastic	Total Waste Plastics Generated Tonnes	Total Waste Plastics Recovered Tonnes	Per cent Recovered
HDPE	37,000	2,600	7%
LDPE	6,000	250	4
PET	2,500	2,200	88
PP	20,000	350	2
PVC	50,000	400	<1
PS	22,000	50	<1
ABS	8,000	300	4
Other plastics	50,500	850	2
TOTAL/AVERAGE	250,000	7,000	3%

Source: Compiled from Exhibits III-3 and III-4.

We obtained the figures in Exhibit III-5 through a survey of waste plastics recycling industry participants. In cases where individuals were unwilling or unable to provide information about their operations, we used a combination of other sources to estimate the figures. These sources included competitor estimates, supplier and customer estimates, population ratios and import/export data. These figures thus represent only an approximation of recycling activity and largely do not capture industrial waste exported from the province that is not channelled through a broker.

E. HDPE is the primary waste plastic recovered

The recovery of plastics from the waste stream varies widely by material type. HDPE is recovered in greater volumes than any of the other major thermoplastic resins, although PET, which is covered by deposit legislation, has the highest recovery rate. Industry representatives claim that the recycling rate on PET soft drink bottles exceeds 100%, although we estimate its recovery rate at 88%. One possible explanation for greater than 100% recovery is that PET soft drink bottles are brought into the province from adjacent regions where the refund is smaller or not applied. Another explanation is the consumers are tearing the labels off PET alcohol beverage containers (which have a lower refund) and submitting them as soft drink containers.

Given our estimate that 12,500 tonnes of the plastics waste generated in British Columbia is pre-consumer waste, the recovery rate for pre-consumer waste is 19%. This compares with a recovery rate of 3% for post-consumer waste. The reason for the disparity in recovery rates between pre-consumer and post-consumer waste will be explained in subsequent chapters.

F. Waste plastics follow common pathways

Each type of plastic generally follows the same channels of waste generation collection, processing, distribution and disposal. These channels or pathways are illustrated in Exhibit III-6 and described in the following paragraphs.

Waste plastics are generated at two stages in the plastics life cycle: at the pre-consumer stage and at the post-consumer stage. Post-consumer plastic waste represents the plastic consumed by residential and commercial users that becomes part of the MSW stream. As discussed in subsequent sections, this category of plastics waste is typically contaminated and often of unknown composition.

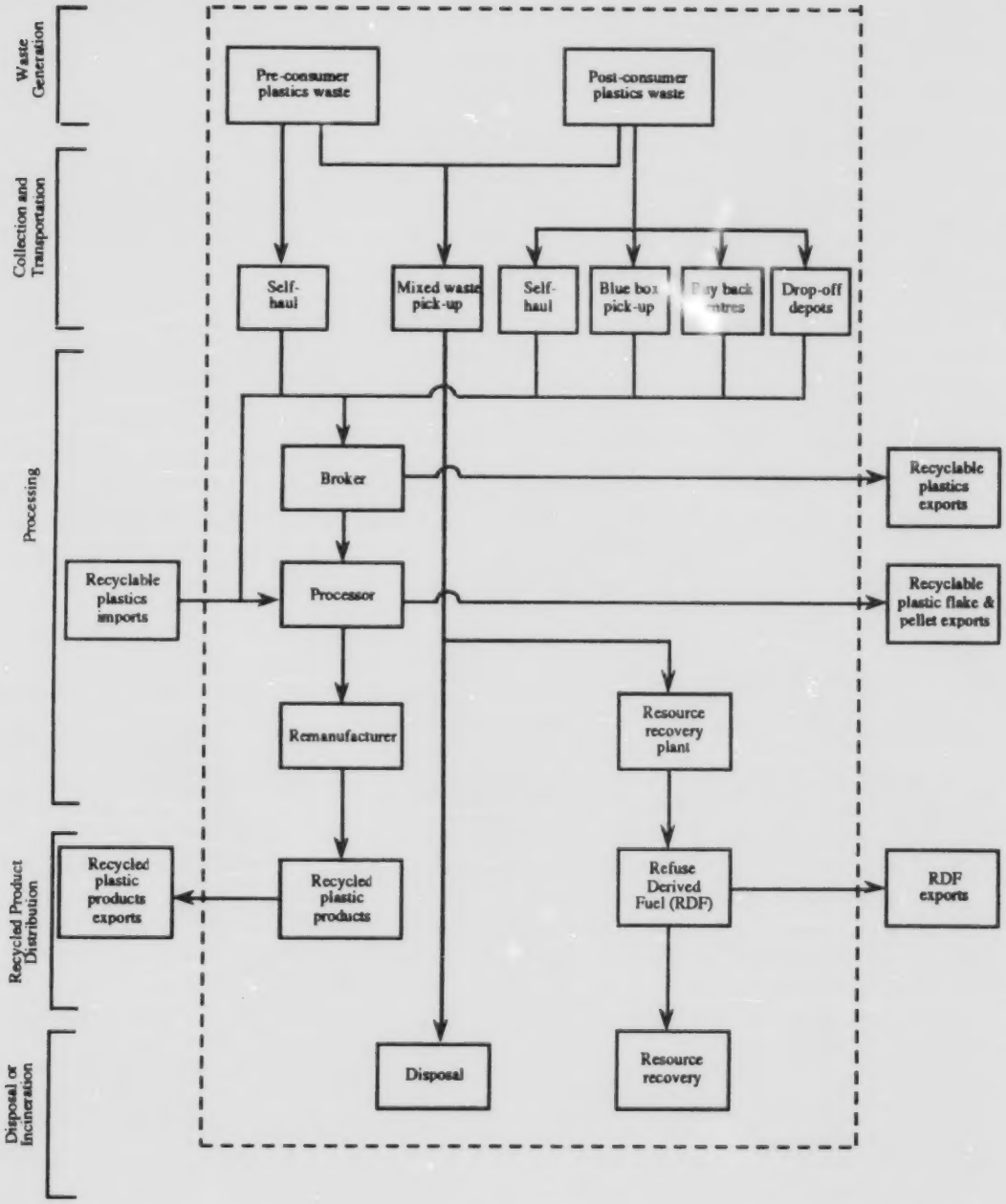
Pre-consumer or manufacturing plastic waste represents the scrap left over from plastics manufacturing and fabricating operations. This material is generally clean and of known composition. It can often be softened and remolded or shredded into pellets for reuse as a raw material. The majority of this material does not enter the MSW stream but rather is reprocessed internally or sent directly to a plastics reprocessor.

Pre-consumer plastics waste that is kept separate from non-plastic waste may be sent to a broker, or directly to a processor for recycling. Unsegregated waste plastic is generally put into the conventional mixed waste stream.

The pre-consumer plastics waste that is combined with other waste materials is generally not recyclable due to contamination. This mixed waste is typically picked up through the curbside collection infrastructure or self-hauled to a disposal site. In almost all cases, the waste plastics are landfilled or incinerated. However, at least one site in the province (Wastech in Coquitlam), sends mixed waste through a materials recovery facility where the recyclable materials are separated from the other types of waste. While a few easily identified plastic materials such as pop bottles and milk jugs are separated, the majority of the plastics are combined with the paper fraction of the waste to produce refuse derived fuel (RDF). The RDF is then exported or used within the province to produce energy through incineration.

Post-consumer waste that is unsegregated from other types of waste follows the same pathway as unsegregated pre-consumer waste: it is put into the conventional mixed waste stream described above.

Exhibit III-6
Lifecycle of waste plastics



Note: Dotted line denotes boundary of activity within British Columbia.

However, source separated post-consumer waste plastics are used more productively. They are transported directly to a broker or collected from buy-back centres, drop-off depots or blue boxes. The broker sorts the waste plastics from other recyclable wastes, and bales the material. It is then either exported for processing or, if sorted by resin type, shipped to a processor within the province. The processor cleans, flakes or pelletizes the material and sends it to a manufacturer of plastics products. Some processors import baled waste plastics from other provinces and export semi-processed material to manufacturers The manufacturer then recycles the material into a new product with recycled content. The final product is sold domestically or exported outside the province.

Manufacturers of plastic products purchase recycled single resins only, or recycled plastic pellets made from plastic waste that has been separated by resin type. This is the kind of recycled resin processing that now takes place in British Columbia. It is also possible to make "comingled recycled resins", from unseparated plastic waste. Comingled recycled resin is generally made into "plastic wood" by a vertically integrated processor. None of British Columbia's processors make comingled recycled resins.

G. Some forms of plastics recycling are preferred over others

Waste plastics can be recycled at four hierarchical levels: primary, secondary, tertiary, and quaternary (see Exhibit III-7). The higher levels of recycling provide more environmental and economic benefits because the waste is recycled more fully and the final product has greater value than would be possible with lower levels of recycling.

Exhibit III-7
Plastics recycling hierarchy

Recycling Level	Activity
Primary	Waste is used to make products of similar characteristics as the original product.
Secondary	Waste is converted into a different product, typically of lower value than the original product.
Tertiary	Basic chemicals and fuels are recovered from the waste.
Quaternary	Energy is retrieved from the waste through burning.

Primary recycling, the highest form of recycling, has been practiced by the plastics industry for some time. However, it has generally been restricted to clean, well sorted material, of known and uniform composition. Recently, a variety of technologies have been introduced to handle post-consumer waste. Only recycled single resins made from separated waste plastics can be used for primary recycling.

Secondary recycling to produce products with less rigourous chemical and physical properties has also expanded in recent years. Both recycled single resins and recycled comingled resins can be used for secondary recycling.

Tertiary recycling, or the recovery of basic chemicals and fuels, has the benefit of being able to accommodate plastics waste with significant contamination. It also has strong potential to be used as feedstock in a wide variety of plastics.

Quaternary recycling of waste plastics is being practiced on a very limited scale in British Columbia and the value of the fuel pellets is generally too low for this to be a long term solid waste solution for the province. We have thus excluded quaternary recycling from our analysis.

H. Barriers to increased plastics recycling exist

1. The collection and transportation infrastructure is poorly developed

Only a small number of communities in British Columbia accept plastics through their blue box programs and depots, and there are no deposits on plastic containers other than soft drink and alcohol containers. A major problem with waste plastic collection is the space used by uncompacted plastic containers. Most plastics reprocessors in British Columbia indicate that they would process much more waste plastic if it was available to them.

2. It is difficult to identify and separate waste plastics

Some plastic products look identical even though they are made of different resins. This makes them difficult to identify and sort at the recycling stage. The plastics industry has initiated a voluntary program whereby plastics producers print or stamp a symbol and code on their plastics products indicating the resin type, but participation is moderate. Appendix E illustrates the symbols and codes.

3. Multi-material plastics are difficult to recycle

Waste plastics that are combined with other types of plastic or other types of materials are difficult to recycle. Even when the individual resins can be identified, it is difficult to separate them. This hinders single-resin reprocessing into products with the same or similar use.

4. Contamination severely reduces the economics of recycling

Waste plastics are often contaminated with other types of plastics or other wastes. Even a small amount of contaminated plastic in a large, otherwise pure load of plastic will reduce the value of the entire load to the value of the contaminated

plastic. Waste plastic that is well sorted and cleaned is worth orders of magnitude more than waste plastic that contains a few contaminates.

5. Recycled plastic food packaging is restricted

The department of Health and Welfare in Canada and, until recently, the Food and Drug Administration (FDA) in the United States do not allow the use of recycled plastic in packaging where the recycled material comes in contact with food or body care products (e.g., shampoo). Recycled plastic can only be used in food or body care packaging when it is sandwiched between two layers of virgin plastic. As over 60% of all packaging is used by the food and beverage industry, this greatly hinders the recycling of plastics back into products with the same or similar use. The recent exception is a statement of non-objection by the United States FDA to the use of recycled PET in soft drink bottles, as long as the recycled resin is broken down to the polymer level.

6. Waste plastics are being exported on long-term contracts

Long-term purchasing contracts are in place for the export of waste plastics to jurisdictions outside the province. Local processors that have recently established operations cannot compete for this feedstock until the contracts expire.

7. Many plastics recycling technologies are unproven

A wide range of waste plastics processing technologies have been introduced in recent years. However, many have not been in use long enough to determine their long-term performance and economic viability. As a result, waste plastics processing firms are reluctant to bear the risks associated with testing them.

8. Some laws and regulations inhibit recycling

Waste plastics processors often face more stringent environmental regulations than virgin resin producers. There are tax inequities and freight rate differences between virgin and recycled materials. Zoning laws occasionally force recycling centres to locate far from waste sources.

9. Plastic waste is light weight and often bulky

Light weight and bulk make plastics less profitable to recycle than some other materials.

10. Incineration is incompatible with plastics recycling

Plastics have a high heat content and are desirable raw material for incineration or resource recovery. Removing the plastic from mixed waste makes the remaining material less easily incinerated. This is an issue for the GVRD, which incinerates about 20% of its waste.

IV

Collection And Transportation Of Waste Plastics

A. Recyclable waste plastics are collected in four primary ways

Recyclable waste plastics in British Columbia are diverted from disposal using four primary collection methods. These include the following:

- **Curbside pickup**—Residents of single-family dwellings put recyclable plastics in special boxes or bags that are collected at curbside by municipal crews. This does not include requests for special pickup of appliances, etc.
- **Drop-off**—Recyclable plastics are dropped off at collection bins or central depots.
- **Buy-back**—Recyclable plastics are returned to retail outlets and some depots for a deposit refund.
- **Self-haul**—Recyclable plastics are transported by the waste generator directly to the broker or processor. Almost all the materials in this category are sourced from non-residential sources (some apartment owners self-haul their recyclable materials).

Exhibit IV-1 summarizes volumes of waste plastics collected by the four methods. Each collection method is discussed in greater detail in the following sections of this chapter.

Exhibit IV-1
Quantity of waste plastics collected within British Columbia by collection method

Collection method	Post-consumer	Pre-consumer	Total
Curbside pickup	700	0	700
Drop-off	600	0	600
Buy-back	2,000	0	2,000
Self-haul	1,350	2,350	3,700
Total	4,650	2,350	7,000

B. Curbside programs—a growing number accept waste plastics

Curbside collection programs, typically called "Blue Box" programs, are being conducted in 22 municipalities in British Columbia. Ten of these municipalities, all located within the GVRD, include waste plastics in their curbside programs. We estimate that about 700 tonnes of waste plastics were collected at curbside from 280,000 single-family dwellings in these municipalities in 1990. This represents about 2.5 kilograms per household per year, or approximately 0.80 kilograms per person per year. In communities that collect only PET and HDPE, the figure is 2.0 kilograms per year. Vancouver, which collects all rigid containers, has a collection rate of 3.3 kilograms per year (1.06 per person); while Port Moody, which includes rigid containers and films, reports 5.1 kilograms per year (1.66 per person). However, this last figure was based on a small number of pickup points and may not be applicable across the province.

Curbside collection of plastics is available to about 29% of the province's population. This is a significant achievement given that no waste plastics were collected through curbside programs in 1989. Other jurisdictions that have been collecting waste plastics for a longer period of time typically receive about 4.5 kilograms per household per year.

A breakdown of the types of waste plastic accepted by curbside programs is provided in Exhibit IV-2. Most municipalities accept only PET pop bottles and HDPE milk jugs to simplify the system (residents have difficulty sorting plastics by resin type). Because of the deposit legislation on PET bottles, about 90% of the waste plastic collected is HDPE. One exception is the City of Vancouver, which accepts all rigid containers. Vancouver officials cannot estimate the amount of HDPE collected because payment is based on the total weight of comingled recyclable materials. A breakdown by commodity is not provided by the broker. Port Moody is in a similar situation.

Exhibit IV-2
Summary of curbside collection programs in British Columbia that accept waste plastics

	HDPE bottles	PET bottles	LDPE bags	Mixed rigid containers
Burnaby	√	√		
City of North Vancouver	√	√		
Coquitlam	√	√		
District of North Vancouver	√	√		
Port Moody	√	√	√	√
Richmond	√	√		
Surrey	√	√		
Vancouver	√	√		√
West Vancouver	√	√		
White Rock	√	√		

Source: Recycling Council of British Columbia, 1990.

The curbside collection and transportation of the waste plastics is generally conducted by one of the following organizations: municipalities, waste transportation companies, or waste brokers. The choice of a collector depends on the degree of source separation desired, the type of vehicles needed, the distance the material must be transported, and the price charged by private sector companies.

Specialized trucks with three to five compartments for each major type of recyclable material (glass, tin, mixed paper, newspaper, plastic) are typically used to transport the materials collected. The waste plastics are put into one compartment or separated into PET and HDPE. Some trucks have moveable interior partitions while others have moveable bins that can be dumped separately when off-loading. None of the trucks handle mixed or non-recyclable waste. In Port Moody, where the residents put their recyclable materials in comingled bags, the bags are taken to a broker for sorting.

Other jurisdictions in North America have begun putting densification equipment on collection trucks, especially where plastics represent a significant portion of the materials collected. A recent study commissioned by the Council of Solid Waste Solutions stated that the decision to install such equipment should consider the following:

- The extra time spent densifying is generally more important than the volume reduced.
- The equipment must be able to achieve volume reductions of 9:1.
- A broker must be able to sort or process densified containers.
- The collection and densification must be performed by one person (in addition to the driver).

Municipalities and collectors typically negotiate one of two types of contracts with each other. In one, the municipality pays the collector a flat rate for each household served. The collector can then offset some of its costs by selling collected materials to a broker. In this type of agreement, the municipality typically does not receive feedback on quantities collected.

In the second type of contract, the municipality pays the collector a flat rate for each household served, as well as a processing fee. The municipality receives a portion of the revenue (e.g., 75%) from the sale of collected materials. However, revenues are usually based on a lump sum amount for the total weight of comingled waste (plastics, paper, glass and metal combined). The rates paid/received varies widely between municipalities. Furthermore, the rates are set for all recyclable materials combined; waste plastics are not distinguished separately.

The costs of curbside collection far exceed the direct revenues from the sale of the recyclable materials and avoided landfill costs at current landfill charges. Collection and transportation costs are currently paid for through municipal property taxes. As such, curbside collection is provided as a municipal service that is supported by the taxpayer because it is the most convenient recycling method for most residents of the community.

C. Depots—less convenient but more widely available

Depots and drop-off bins for recyclable materials are operated in most municipalities in the province. We estimate that about ten accept waste plastics. The majority of these are located in the GVRD. We estimate that about 600 tonnes of waste plastic are collected through depots.

While curbside programs are primarily restricted to single-family dwellings, depots provide a convenient means of recycling to apartment dwellers and businesses.

Three types of depots operate in British Columbia. These are:

- Municipal depots.
- Private sector depots.
- Not-for-profit (NFP) depots.

The vast majority of depots are run by municipal governments and NFP organizations because revenues do not exceed costs. Because of the relatively low market price for recyclable plastics, most private depots collect only PET bottles. They pay a lower refund than is paid by retailers (e.g., 20¢ rather than 30¢ per bottle) and return the PET to the bottlers for the full refund, or ship it to the brokers. In most cases a retailer or bottler refuses to refund the deposit if the people returning the bottles did not purchase the full containers at a retail outlet.

In many cases, depots do not bale collected materials, which are often given, free of charge, to brokers.. In fact, some depots pay a broker to receive, bale and market the materials collected. Experience in other jurisdictions suggests that, as a larger number and wider range of plastics are accepted, the purchase of a baler becomes justified. Baled waste plastic can be sold to brokers or processors.

Although less convenient than curbside programs, depots offer a number of advantages. For example, with an attendant present, depots can achieve a high level of sorting. Depots can also be used as demonstration facilities to increase public awareness of recycling and understanding of sorting. Further, depots are low cost: collection costs are minimal or non-existent and materials are free. Costs are incurred only to manage the depot and ship materials to brokers or processors.

If a depot is equipped with a baler, operators can often ship directly to processors, bypassing the broker and getting a higher rate of return for materials collected. Balers also reduce the need for storage space, a significant problem given plastics' high volume to weight ratio. With reduced need for storage, the depot can often expand to serve ICI post-consumer waste generators.

Shipping costs are also a consideration, especially in remote areas. For example, shipping baled HDPE from Prince George to Vancouver costs about $50-$75 per tonne

based on a fully-loaded 40-foot trailer. Shipping unbaled product would cost five to ten times this amount. A baler is therefore a necessity if the depot is distant from the processor.

Sorting and baling capabilities have a significant impact on depot profitability. The ability to mechanize the facility will determine the quality of goods shipped and prices received. A baler significantly reduces shipping costs. An off-the-shelf baler costs about $15,000 and will pay for itself within two years, according to some depot operators contacted.

D. Buy-back programs—strong possibility of expansion

In British Columbia, deposit/refund legislation is in place for certain types of alcohol and beverage containers. The only plastic material to which the legislation applies is the one and two litre PET soft drink and beverage alcohol containers. Consumers pay a 20¢ or 30¢ deposit which is refunded when containers are returned to the retailer.

According to the local soft drink bottlers, the refund rate on PET bottles is 85-90%, amounting to 2,000 tonnes per year. Many of the remaining bottles are collected through blue box programs and depots.

The provincial government is considering expanding the deposit legislation to cover a wider range of beverage containers. If the legislation is applied to plastic containers, it will have a significant impact on waste plastics recovery. Also, a new collection and transportation infrastructure may have to be established to handle the increased flow of materials.

E. Self-haul—many niches for private sector firms

While depots and buy-back programs are used only for post-consumer waste,plastic, both pre-and post consumer waste plastic are self-hauled. Waste plastics collected by this method are derived almost entirely from ICI sources. This collection method was used for about 3,700 tonnes of waste plastic in 1990, over half of total plastics waste collected.

Self-hauling is typically used to transport large quantities of relatively clean and homogeneous recyclable plastics. While some self-hauled material is transported to a broker, the majority is shipped directly to a processor. The transportation costs are borne by the waste generator or the processor, depending on the value of the material and the transportation equipment available. The waste generator and processor typically sign long term contracts that stipulate who will be responsible for transportation costs and what payments will be made. The success of the processor is highly dependent on its ability to obtain a long-term, secure source of supply.

Self-hauling is strictly a private sector activity and market forces traditionally have dictated the level of recycling activity. Transportation economics typically depend on the

market price of the resin collected, the degree of contamination and the volume supplied. More and more companies are self-hauling their wastes to processors to avoid paying landfill tipping fees.

For example, one company collects buckets from the food service industry in the Lower Mainland. It collects used buckets on a regular basis, cleans them, and sells them for reuse. If the pails are cracked or heavily stained, the company breaks them into flakes and sells the flakes to processors. The firm charges many of its customers to haul away the used buckets, but pays other customers that supply a large quantity of relatively clean, unstained buckets.

A number of retailers have recently initiated plastics recycling programs, primarily to satisfy growing customer demands. For example, one of the dairies collects yogurt and other dairy containers and is operating the program at a loss to stop the decline of its home delivery program.

Strong potential exists to expand self-haul arrangements between processors and ICI waste generators. Barriers to expansion include low prices received for waste materials and an attitude among some industrial suppliers of high grade material who would rather send their cuttings to landfill than give them to a recycler who sill make a (small) profit.

F. Mixed waste is not recyclable

While municipalities have made major efforts in the past year to increase the amount of source separated waste plastics, the vast majority is still collected as unsorted, mixed waste. This material is collected at curbside from residential sources and self-hauled from most ICI sources. In British Columbia, it is then either disposed of in a landfill, incinerated, or taken to a Resource Recovery Plant (RRP). RRPs are facilities designed to recover secondary materials and energy from mixed waste. They generally produce refuse derived fuel (RDF) pellets as part of the output stream. The pellets are made by separating out the non-combustible wastes and shredding and compacting the remainder (primarily paper and plastics) to produce a fuel source of uniform consistency and heating value.

In British Columbia, a variation of an RRP is operated by Wastech in Coquitlam. At this facility, the mixed waste is placed on a conveyor belt and recyclable materials such as glass and metal are separated out in a combined mechanical and manual process. While the intention of the firm was to process the plastic and paper into RDF, none is being produced due to lack of markets. Wastech does not operate an incinerator.

Two other RRPs are planned for construction in the province. Markets for RDF in British Columbia appear to be poor. This is perhaps because a significant amount of wood waste is available in the province for resource recovery.

V

The Waste Plastics Reprocessing Industry

A. The waste plastics reprocessing industry in British Columbia comprises 19 firms

The waste plastics reprocessing industry in British Columbia is small, but growing. A total of 19 firms participate in the process of converting both pre-consumer and post-consumer plastic waste into new products. These firms fall into one of three categories:

- **Brokers**—companies that receive plastic waste from the collection infrastructure and perform a cleaning, sorting and baling function.
- **Processors**—firms that purchase plastic waste either from brokers or directly from waste generators, reclaim usable resins in the form of flakes or pellets, and provide these raw materials to remanufacturers.
- **Manufacturers**—firms that use reclaimed resins to manufacture new products with recycled content. The new products are rarely 100% recycled material; most contain a mixture of reclaimed and virgin plastic resins.

As recently as three years ago, the waste plastics reprocessing industry in British Columbia was comprised of brokers only. These companies received and baled waste plastics, exporting the baled waste. Exports were generally destined for the Far East where inexpensive labourers further sorted the materials for recycling. Advances in reclamation technologies and growing interest in recycling in general, encouraged processors to enter the industry during the late 1980s. Today, we estimate that the annual sales of waste plastic in baled (brokers' sales) and reclaimed resin (processors' sales) form at about $3.3 million annually in British Columbia.

Technically, manufacturers also have a lengthy history in waste plastics reprocessing in British Columbia. The primary business of these firms is the manufacture of plastics products using virgin resins. Many of these companies have recycled their own clean, production waste for years and have therefore technically participated in the recycling process. However, it is only recently that plastic product manufacturers have begun to purchase reclaimed resins from independent local processors, and to focus on increasing the recycled resin content of their products as a business strategy.

A list of the major participants in the waste plastics reprocessing industry in British Columbia and the materials they handle is provided in Exhibit V-1.

B. Brokers are primarily exporters of waste plastic

1. Seven waste plastics brokers operate in British Columbia but only three deal with a variety of MSW plastics

Seven companies in British Columbia can be classified as brokers of waste plastics. However, four of these firms are beverage distributors that handle only PET bottles. The bottles are baled and exported to Wellman Inc. (Wellman) in South Carolina, the largest processor of PET in North America.

The three remaining companies, Environmental Technologies Limited (ETL), International Paper Industries (IPI), and Riteway, are the only brokers in British Columbia that handle a variety of plastic waste. These brokers handle a wide range of waste products and plastics play a relatively minor role in their business as a whole. The following discussion pertains primarily to the activities of these three firms.

The waste plastic handled by British Columbia's brokers comprises almost exclusively post-consumer residential and ICI waste. Post-consumer residential waste is sourced from blue box programs and depot drop-off centres while institutional waste tends to be collected directly by the brokers. British Columbia's brokers have negotiated a variety of contractual agreements with the operators of blue-box and depot programs (B.C.'s municipalities), ranging from paying the municipality for the waste, to being paid by the municipality to "sort and market" waste products.

In general, mixed recyclable wastes are delivered by municipal vehicles or commercial waste haulers to brokers' depots. The waste has usually been sorted into broad categories (newspaper, mixed paper, metal cans, glass and plastic) during the collection process. The materials are further sorted (by hand) by the broker. They are then compacted, baled, and shipped.

2. Materials handled

We estimate that British Columbia's brokers handle a total of about 4,200 tonnes of plastic waste annually. Brokers focus on procuring easily marketed wastes: HDPE and PET. Of the estimated 4,200 tonnes, we estimate that about 75% is accounted for by these two materials.

Exhibit V-1
Curbside collection programs in British Columbia

	Paper	Glass	Metals	Plastics
Greater Vancouver Regional District				
Burnaby	news mixed	all clrs	tin/alum	HDPE PET
Coquitlam	news	all clrs	tin/alum	HDPE PET
Delta	news	all clrs	tin/alum	
Langley (Twnsp)	news	all clrs	tin/alum	HDPE PET
Maple Ridge/ Pitt Meadows	news	all clrs	tin/alum	
New West	news mixed milk crtn	grn/clr	tin/alum	
North Shore	news	all clrs	tin/alum	HDPE PET
Port Moody	news mixed milk crtn	all clrs	tin/alum	HDPE LDPE PET
Richmond	news	all clrs	tin/alum	HDPE PET
Surrey	news	all clrs	tin/alum	HDPE PET
Vancouver	news	all clrs	tin/alum	Rigid
White Rock	news	all clrs	tin/alum	HDPE PET
Capital Regional District				
Equimalt	news	all clrs	tin/alum	
Oak Bay	news	all clrs	tin/alum	
Saanich	news	all clrs	tin/alum	
Saanich Pen.	news	all clrs	tin/alum	
Saltspring	news	all clrs	tin/alum	
Victoria	news	all clrs	tin/alum	
Western Communities	news	all clrs	tin/alum	
Regional District of Nanaimo				
	news	all clrs	tin/alum	
Other Programs				
City of Nanaimo	news/corr			
City of Kelowna (pilot)	mixed corrugated ledger	all clrs	tin/alum	

Source: Recycling Council of B.C.

3. Markets for brokered materials

Virtually all of the waste plastic handled by British Columbia's brokers is exported—PET to the United States, and HDPE and other plastics to Asia. The brokers separate PET and some HDPE but sell primarily baled, comingled plastic waste. We estimate that only a small quantity of HDPE remains in the province for processing.

The price received by brokers for baled waste plastic depends on sorting quality, colour, cleanliness, resin type and the price of virgin resins. British Columbia's brokers sell to export markets for two reasons: long term contracts are in place and most of the plastic waste they receive is comingled, necessitating further sorting before processing can take place. Low labour costs make this second sorting viable in Asia.

4. Total waste recovery and brokers' activity

Of the estimated 7,000 tonnes of plastic waste recovered from British Columbia's MSW stream annually, we estimate that 2,350 tonnes is pre-consumer waste, while 4,650 tonnes is post-consumer waste. The 4,200 tonnes handled by brokers is virtually all post-consumer waste. Brokers' activities are therefore estimated to account for about 60% of total plastic waste recovered in the province, and 90% of post-consumer plastic waste recovered.

The brokers' ability to expand activities is constrained primarily by the supply of waste plastics recovered in the province. Given an adequate supply, there appears to be ample demand.

C. The processing industry is in its infancy

1. British Columbia has eight plastic waste processors but only two are dedicated solely to processing activities

Eight firms can be classified as waste plastics processors in British Columbia. They fall into three categories:

- Those that process only battery casings, made of PP. (These firms also act as brokers, procuring the waste PP. We have not included them in our tally of brokers operating in British Columbia because of the unique nature of their business.)
- Those that are vertically integrated into manufacturing plastic products.
- Those that act as waste plastics processors only.

Two processors operating in British Columbia, Metalex Ltd. and K.C. Recycling Ltd., focus exclusively on the battery market and the processing of PP. These firms recover and process a total of about 240 tonnes of PP from the British Columbia plastics waste stream annually. They import an additional 2,200 tonnes of PP from outside the province.

Four plastic products manufacturing firms also process waste plastics for use in their own operations.[1] Flexpac International Ltd., Ellehammer Industries Ltd., and Hilinex Packing Inc. purchase small quantities of post-consumer HDPE and LDPE for processing and incorporation in the manufacture of horticulture products, grocery and garbage bags. Listo Products Ltd uses the material to make horticulture pots. Some of this HDPE is imported from outside the province.

Only two firms in the province are dedicated solely to reprocessing plastic waste—Eco-Pac Industries Ltd. (Eco-Pac) and Merlin Plastics Supply Inc. (Merlin). Both were established within the last three years and both initially focused on processing HDPE. However, their primary source of supply and end markets differ substantially.

Eco-Pac was established in September of 1990. The firm processes HDPE milk jugs and pails sourced exclusively from the post-consumer waste stream. Eco-Pac washes and grinds the waste plastic, separating the HDPE resin from contaminates such as paper and glue and sells the reclaimed HDPE in flake form. Eco-Pac sells its HDPE flake back to the original plastic film producer (this practice is called "tolling") as well as to out-of-province markets. Its primary customers are British Columbia plastic products manufacturers.

Merlin also processes HDPE but focuses almost exclusively on pre-consumer scrap. This firm washes, grinds, extrudes and pelletizes the waste material, selling its finished product in pellet form. Merlin also processes some pre-consumer PVC, LDPE, and ABS.

2. Total waste recovery and processors' activity

Of the estimated 7,000 tonnes of waste plastics recovered in British Columbia annually, we estimate that about 51%, or 3,600 tonnes, is processed in the province. Most of this is pre-consumer waste, and most is HDPE. About another 2,500 tonnes of PP is processed by the battery casing processors. Most of this PP is imported from outside the province.

---

[1] *There are 161 plastic products manufacturing firms in the province. We interviewed eight companies, which are reported to be the major users of recyclable plastics. It is possible that some other firms also incorporate small amounts of recycled resins in their products. Our calculations make some allowance for this possibility.*

The majority of the waste plastic recovered and processed in the province is sold to customers in British Columbia, with the exception of PP, which is exported.

We understand that both Merlin and Eco-Pac are planning to expand. Their ability to do so effectively is constrained by the supply of high quality waste plastic available from the province's collection infrastructure.

3. British Columbia's processors handle relatively pure resins only

Both Eco-Pac and Merlin use processing technologies capable of handling only relatively clean, single resins. Primary recycling of these relatively pure resins is possible and this type of processing is preferable to other possible processes, from both an economic and an environmental stand-point. (As noted in Chapter III, primary recycling creates high value goods and lengthens the life cycle of virgin resins, which can be recycled many times.) However, these technologies cannot be used to process comingled plastic waste. Several technologies do exist to handle this portion of MSW. A number of potential new entrants to the industry propose to process comingled waste plastic, as described later in this chapter.

4. The economics of processing waste plastics appear favourable

While the processors we interviewed would not provide details of their cost structure and profitability, we were able to obtain some general data on the economics of waste plastics processing from the Plastics Recycling Foundation in the United States.

Their research indicates that the cost of reclaiming plastics, especially PET, HDPE, and PS is very low compared with the cost of making virgin polymers. The initial capital investment for a waste plastics recycling plant is about $2 million to $5 million. The plant can be located either near the organizations (brokers, companies, municipalities) that supply the waste plastics or near the plastics manufacturers that buy the recycled polymers. A rough breakdown of costs is provided below.

Activity description	Costs for virgin plastics ($/tonne)	Costs for recycled plastics ($/tonne)
Equipment installation	$500-2,000	$50-300
Raw material purchase	700-800	0-200
Polymer manufacturing	900-1300	500-700

It is relevant to note that if the landfill tipping fees rise above $100/tonne, organizations will pay to have their waste plastics recycled, thereby improving the economics further.

D. Eight British Columbia plastic products manufacturers use recycled resins

1. Eight plastics manufacturers use reclaimed resins

We have identified eight British Columbia plastics manufacturers that incorporate recycled resins in their products. Four of these firms are also processors, and were named above. The remaining four are Ropak-Capilano Ltd., PCL Plastics, Premo Plastics, and Plasco Manufacturing.

All of these companies have been involved in handling their own production scrap for several years. They use equipment that either continuously feeds scrap back into the production process, or stand-alone recovery equipment and reblend units.

Essentially all of the recycled resins used in plastics manufacturing processes by these firms are HDPE and LDPE. In addition to materials processed in-house, some of this recycled resin is purchased from local processors, and some is imported from outside the province. The recycled resins are incorporated in products like horticultural containers, chemical bottles, garbage sacks and grocery bags. Some products, like flower pots and garbage bags, are manufactured with 100% recycled resin while others incorporate only a small percentage of the reclaimed material.

2. Volume of recycled resins used by British Columbia's manufacturers

British Columbia's manufacturers use about 2,700 tonnes of resins reclaimed from the B.C. MSW annually, or 39% of the total. All remanufacturers interviewed state that they would use more reclaimed resin if it were available.

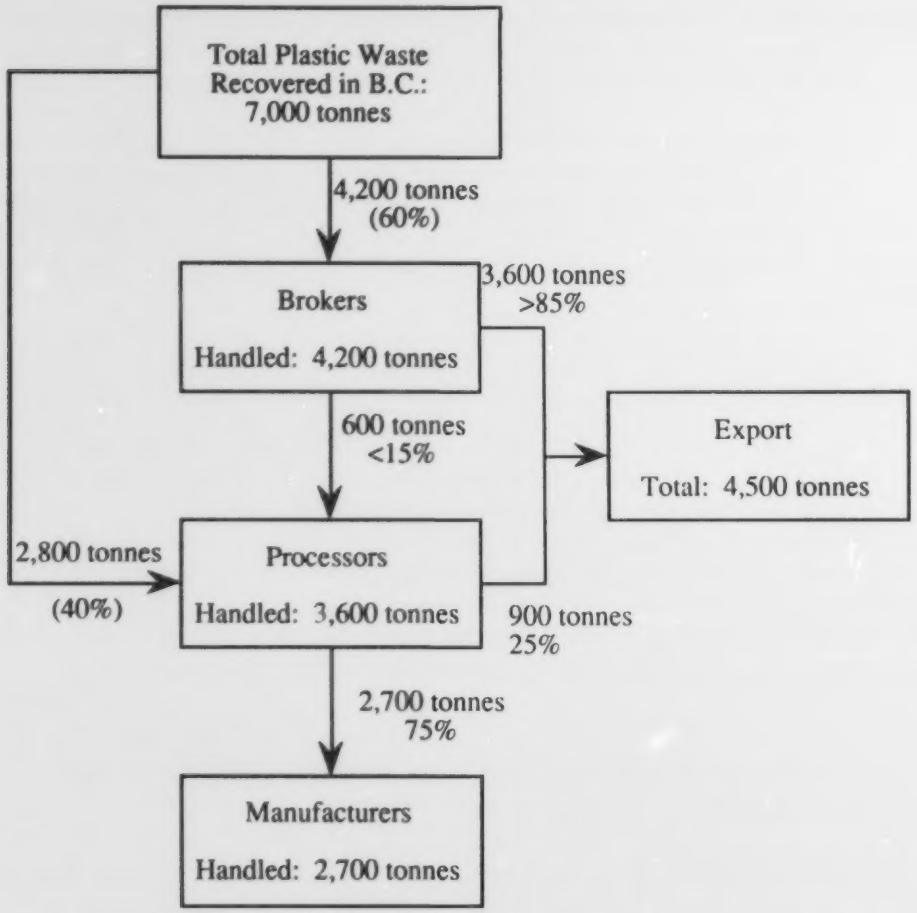
E. Putting it all together—what happens to B.C.'s recovered plastic waste

Exhibit V-2 illustrates the handling of British Columbia's recovered waste plastics, once they have passed through the collection infrastructure.

An estimated 60% of waste plastic is handled by brokers. Of this amount, most is post-consumer waste and most is exported to either the United States or Asia.

An estimated 40% bypasses the broker, moving directly from the waste collection stage to the processor stage. Most of this is pre-consumer waste. The majority of reclaimed resins remain in the province and are used by plastic products manufacturers. (Manufacturers recover a negligible amount of plastic waste directly from the collection level of the industry.)

Exhibit V-2
Handling of British Columbia's recovered waste plastics



At present, the link between broker and processor is weak. Both brokers' long term contracts with out-of-province buyers and the purity requirements of processors limit the volume of recovered waste that can pass from broker to processor. This situation could change if brokers' sorting capabilities improved, or if processors' of comingled plastic waste were established in British Columbia.

F. Some recyclable plastics are not being processed

The preference of both brokers and processors for PET and HDPE is reflected in the collection infrastructure of the province. The recovered volume of these plastics far exceeds that of the other plastics examined in this study.

This situation is not unique to British Columbia. In the United States, current recycling of post-consumer plastics also focuses almost exclusively on containers made from these two resin types. A market has developed for these reclaimed resins largely because the technology exists to both recover the waste and reclaim the resin. PET and HDPE containers are relatively easy to identify and are not degraded significantly by reprocessing.

The recycling of other post-consumer plastics is negligible throughout North America. To date, efforts have focused on containers and packaging. Polystyrene (PS) recycling began in 1989 at two pilot-scale plants in the United States, and more limited experiments are underway on post-consumer PVC. Most PVC recycling efforts are focused on contaminated pre-consumer waste. Post-consumer recycling tends to focus on finding ways to reuse PVC bottles. These bottles are more difficult to identify than PET and HDPE bottles, and are used primarily for products with a lower turnover rate (e.g., shampoo and vegetable oil) than beverage containers. It is relevant to note that strong demand exists from consumers to have these materials recycled. In addition, some small scale recycling of comingled post-consumer plastics is occurring. This activity focuses on secondary recycling and the production of products like wood substitutes.[1]

G. Potential new entrants are interested in the processing and manufacturing levels of the industry

We interviewed a number of potential entrants to the waste plastics reprocessing industry. Most of the firms interviewed were at the preliminary planning stage only, and several had abandoned their plans altogether.

Of those that are continuing to develop their project ideas:

- Three are planning to establish primary recycling operations, reclaiming single resins. In addition, both Eco-Pac and Merlin have plans to expand their operations in this area.

- Three are planning to establish secondary recycling operations, using post-consumer, comingled plastic waste as an input. These operations would be vertically integrated, manufacturing wood substitute products.

---

[1] *Congress of the United States, **Facing America's Trash**, p. 168.*

- Three are planning to produce new consumer or industrial products, using recycled resins.

The limited supply of waste plastic available from British Columbia's collection infrastructure is likely to be the primary constraint on the successful establishment of new waste plastics processors. One of these firms stated that they intended to process more than 6,000 tonnes of post-consumer plastic waste annually, significantly more than is now recovered from the waste stream. Others had similar plans.

H. Some collected waste plastic may be going to landfill

Through our discussions with industry participants and our analysis of import/export statistics, it appears that some collected waste plastics are being landfilled. These materials are generally too contaminated or poorly sorted to be processed economically. This situation will improve over time as the collection and transportation infrastructure improves, as consumers become more aware of the need to provide clean materials, and as technologies come on line to sort and clean waste plastics.

VI

Markets For Waste Plastics

The British Columbia plastics industry comprises 160 firms covering the full spectrum of products and processes. Exhibit D-12 in Appendix D summarizes the distribution of firms, sales and employment, by type of processor.

A. Two markets exist—one for recycled single resins, another for recycled comingled resins

The economic feasibility of recovering waste plastic from MSW is dependent on markets for recycled plastic resins. Manufacturers' demand for recycled input must pull waste through the broker and processor levels of the industry.

Recycled single resin, made from separated waste plastic, is a substitute product for virgin resin: the basic technologies used to make products from virgin resin can also be used to make products from recycled single resin. The demand for recycled single resin is therefore directly linked to the demand for virgin resin.

By contrast, comingled recycled resins, made from unseparated waste plastic, are not substitutes for virgin resins. Comingled resins can be used to replace materials like treated lumber, but are not mixed with virgin resins to manufacture plastic products.

Recycled single resins can be used as input to primary recycling activities, making products of similar value to the original product (bottles to bottles), or for secondary recycling activities, making products with a lower value (bottles to flower pots, or plastic wood). Recycled comingled resins can only be used for secondary recycling activities, making relatively low value products like flower pots or plastic wood. Recycled single resins therefore have a much higher market value than recycled comingled resins.

B. Strong local markets exist for recycled single resins

British Columbia's two major processors produce recycled single resin plastic flakes and pellets. Most is HDPE, and most is sold to plastic product manufacturers in British Columbia. The potential local demand for recycled single resin greatly exceeds available supply. We estimate this potential demand at 10,400 tonnes, as illustrated in Exhibit VI-1.

Exhibit VI-1
Estimate of potential B.C. demand for recycled single resin plastics

Resin	Non-food container virgin use	Potential Recycled Content	
	Tonnes '000	%	Tonnes '000
LDPE	10	10	1.0
HDPE	17	15	2.6
PS	7	15	1.0
PVC	14	20	2.8
PP	6	15	0.9
PET	2	15	0.3
Other	12	15	1.8
	68		10.4

Source: Adapted from the Society of Plastics Industry as per 1991 consumption figure in Appendix D, Exhibit D-8, and the survey of industry participants, March, 1991.

This estimate is derived from the total consumption of virgin plastics in British Columbia, less the estimated tonnage used for food packaging containers that cannot incorporate recycled resins. Estimated virgin tonnages are multiplied by the expected maximum use rates of recycled resins—10% for resins used to manufacture films, 20% for resins used for non-film products, and 15% for resins used to make both film and non-film products (survey of industry participants, March 1991).

British Columbia accounts for about 6% of Canadian resin use. We have made the large assumption that half is used for non-food containers, and that the ratios of the different resins are the same for British Columbia and for Canada. We have no firm data on this, so individual resin values may be quite inaccurate. However, we believe that the total is a reasonable approximation of potential demand for recycled single resin.

Today, British Columbia's processors supply manufacturers with a total of 2,700 tonnes of recycled single resin pellet, only 26% of the aforementioned estimated potential demand.

C. Markets are more developed for some recycled single resins than for others

Current recycling of post-consumer plastic waste throughout North America is focused almost exclusively on containers made from two resins, PET and HDPE. These containers are relatively easy to identify and are not degraded significantly by reprocessing. Markets for recycled PET and HDPE resins are therefore quite well developed. Markets for recycled LDPE and PS are beginning to develop.

1. PET

Demand for British Columbia's waste PET is strong. Virtually all of the PET recovered from the waste stream is shipped to Wellman in South Carolina. Wellman has signed multi-year contracts with both Coca Cola and Gray Beverage to supply the province's PET bottles. PET pellets are used internally to manufacture nylon and polyesters (84% of their business) or sold to various plastics products manufacturers.

While local demand for PET is also strong, British Columbia's processors are unable to secure a source of supply, given the Wellman contracts. The first of these contracts expire at the beginning of 1993.

2. HDPE

Demand for recycled HDPE is strong. British Columbia's processors focus on this resin and have no difficulty selling the recycled pellet to plastic products manufacturers. Processors report paying $200 to $250 per tonne for clean, baled HDPE. The recycled pellet sells for about $730 to $770 per tonne.

Manufacturers use about one half of British Columbia's recycled HDPE resin as input to a primary recycling process, producing pails and containers. The balance is used in secondary recycling activities.

3. LDPE

Demand for recycled LDPE is strong in British Columbia today. Processors buy clean, baled LDPE for an undisclosed price, selling pellet for as much as $1,100 per tonne. Local strong demand for plastic bags with recycled content accounts, to a large extent, for the high value of recycled LDPE pellet—supermarket chains in particular are willing to pay a premium for bags with recycled content.

More than two thirds of the province's recycled LDPE resin appears to be used in high value primary recycling processes (making plastic bags), while the balance is used in secondary processes.

4. Other recycled single resins

Although demand exists at the manufacturer level for other recycled single resins, virtually none are provided by the processing level of the industry. As discussed in the previous chapter, this situation is not unique to British Columbia.

Growth of these markets is constrained largely by the lack of clean, separated waste. While pre-consumer PS, PP, PVC and ABS are readily recycled, their post-consumer counterparts are difficult to identify and can be difficult to clean and separate.

Notable exceptions are PP used in battery casings, which is easily identified and separated from the waste stream. Significant quantities of PP are processed in British Columbia but most is imported from out-of-province. PS, used in fast food packaging and stereo and electronic goods packaging, is also easily identified and can be sourced directly from businesses. Merlin plans to install a polystyrene processing facility late in 1991.

D. Waste plastics processors in Alberta and Washington State can be considered customers and competitors

Waste plastics processors in Alberta and Washington State can serve as end markets for British Columbia brokers or as competitive threats to British Columbia processors. To date, however, they have primarily served their local markets.

Alberta has one processor of PET called Agra Industries. Agra has a capacity of 4,500 tonnes per year but is currently operating at 50% capacity. They can easily handle all of British Columbia's PET feedstock so it is unlikely that a competing PET processing plant will be constructed in British Columbia (current PET feedstock is being shipped to South Carolina). Alberta has a few other companies that recycle other items such as plastic bags, pesticide containers and styrofoam. These firms include New Alta, Polymont, Precision Products, and Wild Rose Manufacturing. To our knowledge, they do not buy from, sell to or compete with British Columbia firms.

Washington State has two major plastics processors: Denton Plastics and Ranier Plastics. These two firms process 90% of Washington State's waste plastics. Denton Plastics is operating at 80% of a maximum capacity of 12,000 tonnes per year. They process mostly post-industrial waste plastic and some post-consumer commingled waste plastic.

Ranier Plastics is operating near its capacity of 10,000 tonnes per year. It processes primarily HDPE and LDPE plastic and only from post-industrial sources. It sells about 140 tonnes/year of its end product (pellets) to British Columbia manufacturers. It has stated plans to gain a bigger share of the British Columbia market.

E. Recycled single resins compete directly with virgin resins

Users of virgin resins consider several factors before incorporating recycled resins in the manufacturing process. These include: the price of the recycled resin, its purity and strength, and the function of the end product.

1. Price

Virgin plastic resins are essentially a global commodity. Prices move up and down with the price of oil, a major input to the plastic manufacturing process. The price for virgin resins paid by manufacturers of plastic products also varies with quantities ordered and transportation costs.

Prices for recycled single resins are directly related to prices for the virgin material. As oil prices fall, so do prices for both virgin and recycled resins. While a drop in oil prices would have little effect on virgin plastics manufacturers' margins, the effect on waste plastic processors could be significant. Because collection, transportation and processing costs do not vary, the viability of waste plastics processing is significantly influenced by forces outside the industry's control.

Exhibit VI-2 lists current prices for virgin and recycled resins purchased in large volumes (a 20-tonne truckload).

Exhibit VI-2
Prices for virgin and recycled plastic resins ($US)

Resin and Grade	Recycled ($/T)	Virgin ($/T)	Mean recycled price as a % of mean virgin price ($/T)
HDPE—Dairy, blow molding	730 - 770	1,010 - 1,060	72
LDPE—G-P, injection	1,100*	990 - 1,010	110
PET—bottle resin	770 - 790	1,430 - 1,470	54
PP—injection, homopolymer	350 - 570	900 - 950	50
PS—G-P crystal	680 - 880	1,080 - 1,100	72
PVC—Pipe	400 - 480	750 - 770	58
ABS	N/Av.	2,090 - 2,130	--

G-P=General Purpose

Source: Plastic News. March 11, 1991

**Interviews with local processors.*

Exhibit VI-2 underlines the strength of markets for recycled HDPE and PS resins—the relatively small price difference between the recycled and virgin products reflects a high market demand for these recycled resins in North America. The price of recycled LDPE is based on local market pricing and is trending downward. This price reflects both local supermarkets' demand for bags with recycled content, and processors' high cleaning costs. Processors' costs have come down significantly in the past year, as better educated consumers return cleaner bags for recycling.

In general, the observed price difference between virgin and recycled resin reflects the lower versatility of the latter. Versatility is affected primarily by the recycled resins' purity and strength, discussed below. A general rule of thumb is that recycled resins must be priced 33 to 50 percent lower than virgin material before a manufacturer will find them worthwhile to use[1] However, supply-demand relationships are not well established and decisions about using recycled resins depend on the unique circumstances of the manufacturer, as illustrated by the current price of recycled LDPE in British Columbia. For example, one major processor in the province has been able to achieve 85% of the virgin price for HDPE.

2. Purity, strength and the end product

The presence of contaminants and the effects of natural degradation on recycled plastic resin are among the most important factors affecting its price, and constraining its use in manufacturing processes.

Contaminants in collected plastics include paper, metals, other plastics, residual products, adhesives, pigments and dirt. These substances can make a plastic technically difficult to recycle and preclude the use of recycled plastics in food containers, as discussed below.

In general, the performance of recycled resins is not as good as that of virgin resins. Reprocessing and environmental exposure degrade some of the properties of the plastic, like durability and dimensional stability. Therefore, the applications of recycled resins are usually less demanding than those of virgin resins. Material strength degradation resulting from reprocessing means that infinite recycling is technically impossible, hence the 10 to 20% recycled content limits assumed in our calculation of potential demand for recycled single resins. While some products (flower pots, plastic wood) are made of 100% recycled resin, most are made of a combination of recycled and virgin resin, with recycled content not exceeding 20%.

In both Canada and the United States, federal laws inhibit the use of recycled plastic in the manufacture of food containers. While not directly prohibited, a federal regulation under the Canada Food and Drugs Act states: "No person shall sell any

---

[1] ***Facing America's Trash, p. 176.***

food in a package that may yield to its contents any substance that may be injurious to the health of a consumer of the food."

This legislation puts the onus on manufacturers to prove that food containers made with recycled plastics do not transmit harmful substances to the containers' contents. The containers are evaluated by Health and Welfare Canada which strongly discourages the use of recycled resins in food containers. Although some processors achieve recycled resin purity in excess of 99.9%, the risk of contamination of food products is considered unacceptably high.

Manufacturers have found two ways of gaining at least partial access to this large marketplace, which accounts for about one half of all plastic containers. First, recycled resins may be used as an outer layer in multi-layer food containers. Second, a process has been developed that allows PET bottles to be broken down to the polymer level and reformed into new PET bottles. While this breakthrough technology is not applicable to all plastic resins, it demonstrates that future research efforts may expand the current applications of recycled single resins.

F. Markets for comingled plastic resins are undeveloped

Markets are limited for comingled plastic waste in North America. Although a manufacturer of plastic wood may soon be established in British Columbia, the majority of comingled waste plastic now recovered from the waste stream is shipped to Asia, typically Hong Kong, China and Korea.

Products made with recycled, comingled plastic resins are technically capable of replacing a portion of the treated lumber market. This market is estimated at two million tonnes in the United States.[1] Assuming that the Canadian market is 10% of the U.S. market, or 200,000 tonnes, and that the British Columbia market is 11% of that, we can estimate a total B.C. market of 22,000 tonnes. However, it is questionable how much and how quickly comingled plastics markets can be developed. Growth appears to be constrained primarily by the low economic value and variable quality of the material. Lack of available, cost effective processing technologies is also an inhibiting factor.

Investment in technologies for comingled plastics recycling is very limited in the United States, and even more limited in Canada. In a research study conducted in 1989, the Office of Technology Assessment of the Congress of the United States could identify only four U.S. businesses using post-consumer waste to produce comingled plastics resins and products—Polymer Products in Iowa; Processed Plastics, formerly Summit Steel Processing Corp., in Michigan, NECR Inc. in Massachusetts; and CPRR in New

---

[1] ***Facing America's Trash, p. 184.***

Jersey. Both NECR Inc. and CPRR began operations in early 1988 and the CPRR facility is a research/pilot-scale operation only.[2]

In addition to competing with the products it is designed to replace, plastic lumber made with comingled resins may also have to compete with plastic lumber products made from recycled single resins. The appearance and properties of the latter can be more easily controlled and are likely to have a competitive edge.

---

[2] *Ibid., P. 184.*

VII

A Scenario For The Year 2000

A. British Columbians will consume 420,000 tonnes of plastics annually

The Society of the Plastics Industry of Canada and Industry, Science and Technology Canada forecast growth rates in plastic consumption—6.5% per year from 1986 to 1991, followed by 5.7% per year to 1996. The total weight of plastic consumed is forecast to grow from 1.644 million tonnes in 1986 to 2.974 million in 1996. If growth continues at the same rate the total weight of plastic consumed by the year 2000 could amount to 3.807 tonnes. Exhibit D-8 in Appendix D summarizes these figures, by resin type. British Columbians, representing 11% of the Canadian population, will consume an estimated 420,000 tonnes of plastic. From year to year plastic waste may vary from plastic consumption. However, over a period consumption will approximate waste.

The following table summarizes total plastic use and packaging use, by resin, forecast for the year 2000.

Resin	Total '000 tonnes	Packaging '000 tonnes
HDPE	56	38
LDPE	101	97
PS	42	14
PVC	88	6
PP	41	12
PET	12	5
Other	80	4
Total	420	176

The per capita use of plastics in total, and of plastic packaging will grow proportionately. Exhibit VII-1 illustrates this growth.

Exhibit VII-1
Estimate of per capita plastics use

	1986	1996	2000
Total (kilograms)	73	119	152
Packaging (%)	38.6	39.5	39.5
Packaging (kilograms)	28	47	60

Sources: 1986 to 1996—Society of Plastics Institute and ISTC, 1987. 2000—extrapolated from 1991 to 1996 growth rate.

Total plastic consumption per capita will increase from 80 kilograms in 1990 to about 150 kilograms in 2000. Packaging, at approximately 40% of the total, will increase from 32 kilograms per capita in 1990 to 60 kilograms per capita in the year 2000.

B. With existing and announced initiatives, 27,000 tonnes could be collected annually

The infrastructure for waste plastics collection incorporates four basic collection methods. By the year 2000, we believe the following recoveries are possible, without significant additional policy assistance.

	1990 (tonnes)	2000 (tonnes)
Curbside pickup	700	2,600
Drop-off depots	600	2,000
Buy-back depots	2,000	3,800
Self-haul	1,350	19,000
Total	4,650	27,400

This represents a recovery rate of 6.5% of total consumption, or 15.5% of packaging waste. United States projections refer to rates of 10% to 40% of packaging waste by the mid-1990's, depending on recycled plastics' share of the treated lumber market.

1. Curbside pickup—2,600 tonnes per year

Areas of expansion for curbside waste plastics include:

- Collection from apartments.
- The addition of waste plastics to existing blue box programs from which they are presently excluded (increased use of the nationally recognized coding system on plastic material will increase the acceptability of other resins in blue box programs).
- The expansion of curbside collection programs to jurisdictions outside of the GVRD and CRD.
- Higher participation rates (through improved customer education).

Present recovery of waste plastics through the blue box system averages 2.5 kilograms per residence per year. In other jurisdictions where blue box programs have been operating for many years, an average of 4.5 kilograms per resident per year can be expected. With an average of 3.2 persons per residence served by curbside pickup, the annual waste per person collected through this method is 1.40 kilograms per year.

Curbside programs now reach 39% of the province's population. Even with an increase to other communities, and the inclusion of apartments in curbside collection programs, we doubt that by the year 2000, more than 50% of the province's population will participate in blue box systems. With a likely provincial population of 3.7 million by the year 2000, a 50% participation rate and an annual volume of 1.40 kilograms per year, curbside collection programs can be expected to generate 2,600 tonnes of waste plastics per year.

2. Drop-off depots—2,000 tonnes per year

The recovery rates in drop-off depots are directly related to recovery rates from curbside pickup systems. Many of the containers deposited in a drop-off bin or depot would be recovered through curbside recycling if a blue box system existed. Drop-off depots would be used in communities where curbside pickup was not provided, and for resins not picked up in existing blue box systems.

We estimate that some 600 tonnes per year are recovered through this method. This figure will increase if depots are expanded into smaller communities. It will fall as some containers are diverted into blue box systems.

Volumes will also increase if resins other than HDPE and PET are accepted. The increased use of the nationally recognized coding system on plastic material will facilitate this, as individual resins will be more easily sorted. The viability of drop-off depots in smaller communities will be affected by volumes recovered, as well as

by whether or not the depot uses a baler. The price difference between baled and unbaled material means that a baler will pay for itself over a volume of 100 tonnes annually.

Assuming the expansion of the coding system for resins, we could expect volumes recovered from drop-off depots will rise by 150 tonnes per year to 2,000 tonnes by the year 2000. The increase would arise mainly in British Columbia's smaller communities.

3. Buy-back depots—up to 3,800 tonnes

At present, PET bottles for soft drinks, ciders and coolers are returned for deposit to retailers. They amount to 2,000 tonnes per year, and can be expected to increase to at least 2,500 tonnes by the year 2000. The provincial government is proposing extending the deposit/refund system to other beverages. However, milk, the beverage which uses the highest number of plastic containers, is expected to be exempted from the legislation. In present circumstances, buy-back volumes of plastic containers are unlikely to increase significantly.

On the other hand, if deposit legislation were extended to milk and fruit juice containers, we would expect the majority of the 1,320 tonnes of HDPE used for these products (22 million containers at 60 grams each), to be recovered through buy-back depots. Our estimate assumes that this legislation is enacted.

4. Self-haul—19,000 tonnes

Self-haul, the practice of waste generators or processors to haul waste directly from the site of generation, applies to pre-consumer and post-consumer waste.

The present recovery of pre-consumer waste is an estimated 2,350 tonnes out of a total weight generated of 12,500 tonnes. We believe that by the year 2000 this recovery rate of 19% can be expected to increase to at least 50% on a far higher base. At projected rates of increase for the Canadian industry as a whole, the 12,500 tonnes of pre-consumer waste will increase to 22,000 tonnes. A 50% recovery rate would result in a supply of 11,000 tonnes of clean, segregated single resin waste.

Post-consumer waste can also be expected to increase. To achieve this, the staff of major waste generators must be trained and required to separate recyclable waste at source by their employers. A recent example of this is the practice of Overwaitea to recycle its pallet wrap. We believe that as markets for recyclables develop, more businesses will take advantage of the potential economic and environmental benefits of recycling waste. Volumes of self-haul post-consumer waste have increased from 0 to 1,350 tonnes per year over a short period. We believe that an annual increase of 750 tonnes is possible in this area, reaching a total of 8,000 tonnes per year by the end of the decade.

5. Materials sorting facilities (MSF's)

Sorting and baling at a central facility could comprise a second infrastructure element although these tasks now fall to brokers. A plant that accepts comingled recyclable materials and separates them into their various components (paper, glass, plastic, metal) is defined in this report as a Materials Sorting Facility (MSF). The design of MSFs to receive and process post-consumer plastics in a cost-effective manner will be critical to the implementation of widespread and effective provincial plastics recycling.

The most successful plant designs incorporate a mix of manual and mechanical separation. Generally, the method of separation depends on: the mix of materials accepted, the sequence of separation, and the type of equipment being used.

MSFs in other jurisdictions in North America have demonstrated that it is economically feasible to separate individual plastic resins from a mixed recyclable materials stream. Currently, HDPE and PET are the most valuable resins and are most frequently separated.

While waste plastic is relatively easy to separate from other recyclable materials, separation by plastic resin is still an emerging technology. Four mechanical separation techniques are either in use or being researched in other jurisdictions. These include the following:

- **Optical scanning**—Plastics are separated based on their colour, opacity, and reflectivity. This technique has severe limitations when the materials are dirty.

- **Bar code scanning**—This method only works for materials that have been bar coded and typically is only effective with small quantities of plastics.

- **Image recognition**—Materials are separated according to the shapes and size. This method typically only works for containers.

- **X-ray detection**—This method is effective in separating PVC from PET and PE but is less reliable for some other resins.

These systems are only effective if the plastics are passed over a sensor one at a time.

Manual sorting will become more feasible when resins can quickly be distinguished through the code on the bottom of the container. The use of this code will be widespread in the future, thereby significantly increasing the supply of clean, relatively uncontaminated, single resin waste.

We believe that an MSF will be constructed in the GVRD area before the year 2000, and possibly in other areas of the province as well. Industry literature

indicates that a minimum population of about 250,000 is needed to support an MSF. Larger facilities are generally more economical. The literature also indicates that a processor can easily afford to pay attractive prices for baled plastic containers that have been sorted into their generic components and still profitably sell its end products.[1]

Industry participants report that a major waste hauler has already proposed to construct and operate such a facility in the GVRD area. The company would require long-term guaranteed waste supply from surrounding municipalities to proceed with this plan.

C. With existing initiatives, growth in the reprocessing industry is expected to at least match available waste supply

All of the participants in British Columbia's plastics reprocessing industry—brokers, processors and remanufacturers—want to expand. However, the expansion that will take place is largely dependent on how the infrastructure develops. We believe that one or more MSFs will be established. This could eliminate brokers from the industry, unless these firms finance and operate the facility.

1. Brokers

British Columbia's brokers separate waste plastic from other recyclables but do little separation by resin type. Of plastic waste handled by brokers, we estimate that 85% is exported in comingled form. This practice is likely to continue, as long as export market revenues cover brokers' costs. Given that many municipalities actually pay brokers to accept waste materials, the future of these firms seems assured, unless an MSF is constructed. Municipalities would then likely guarantee supply to the MSF operator, and sorted post-consumer plastic waste could move directly from the collection infrastructure to the processor, just as pre-consumer waste moves now. We expect that this will occur, and that the brokers' role in the industry will be heavily reduced, if not eliminated, unless they operate the MSFs.

2. Processors

British Columbia's major processors now handle about 3,400 tonnes, or 49% of waste plastic recovered from the province's MSW annually. An additional 2,000 tonnes of imported waste is also processed in the province. Expansion plans by existing processors would bring total provincial capacity to about 10,000 tonnes by 1992. This processing capability will likely cover separated HDPE, LDPE, PET, PS, and PP.

---

[1] *Plastics Recycling Foundation, pg. 4.*

Several entrepreneurs are now planning to enter the market. Some have planned capacity of 5,000 tonnes per annum. The primary constraint to processors' growth is supply of waste. If this constraint is removed, processing capacity will easily expand to handle total recovered waste of 27,000 tonnes by the year 2000. We expect that the establishment of MSF's will mean that most of this capacity will be built to process single resins. However, the establishment of a comingled processing facility is also possible.

While the plastics recycling industry is not well developed enough to make predictions about the future viability of processing plants situated outside the Lower Mainland, the Plastics Recycling Foundation has developed some rules of thumb. Their research shows that it is cost-effective to collect and sort recyclable materials (including waste plastics) in communities of 100,000 or more provided that the landfill tipping fees exceed $45/tonne. Processing plants generally require a community of at least 300,000 population to provide adequate volume of feedstock to be economically viable. The feasibility of transporting baled and sorted waste plastics from communities of 100,000 to larger communities with processing plants depends on the transportation distance and the value of the baled materials.

We belive that it will likely be feasible to process HDPE (and possibly other waste plastics) in the southern part of Vancouver Island and in the interior. One waste plastics processing firm and five virgin plastics manufacturers already operate in the interior. Vancouver Island supports one broker and one manufacturer at present[1]. It may be possible to import feedstock from Alberta or Washington State to further expand the plastics recycling industry but this depends on how quickly their plastics recycling industry develops.

Obtaining financing for new processing facilities is difficult, given the immaturity of the plastics recycling industry and the lack of an adequate infrastructure. While private investors, equity markets, and corporate strategic partners may provide full or partial financing, government assistance, like the province's SWEIP program, will likely be required to help establish this new industry. However, once the collection infrastructure has been put in place, financing should not be a significant barrier to growth.

D. The British Columbia plastics industry could absorb 18,000 tonnes of single resin and 25,000 tonnes of comingled waste plastics, annually

The potential local demand in 2000 for recycled single resin is estimated to be 17,700 tonnes per year as derived from Exhibit VII-2. This figure is derived from the total consumption of virgin plastics in B.C. The resins used strictly for films are multiplied by

---

[1] *Ministry of International Business and Immigration, Plastics Manufacturing in B.C., pg. 32.*

10%, the resins used for other than films are multiplied by 20%, and resins used for both are multiplied by 15%. These are the expected maximum use rates of recycled resin obtained from our interviews with industry participants.

Exhibit VII-2
Estimate of potential British Columbia demand for recycled single resin

	Non-Food Container Virgin Use Tonnes (000s)		Potential Recycled Content 2000	
Resin	1991	2000	%	Tonnes (000s)
LDPE	10	15	10	1.5
HDPE	17	28	15	4.2
PS	7	11	15	1.7
PVC	14	24	20	4.8
PP	6	11	15	1.7
PET	2	3	15	0.5
Other	12	22	15	3.3
Totals	68	114		17.7

Source: Adapted from the Society of Plastics Industry and ISTC 1987, and from Peat Marwick Stevenson & Kellogg survey of industry participants, March 1991.
Assumes B.C. represents 6% of total Canadian production, and non-food use is half of that.

The calculations in Exhibit VII-2 are for the primary recycling sector only, using single resins. Manufacturers using comingled plastics could add significantly to this total. We estimate that current potential demand for plastic substitutes such as treated lumber to be about 22,000 tonnes per year. Assuming a very moderate growth of this market, demand by 2000 could be 25,000 tonnes per year.

The potential total demand is therefore 43,000 tonnes (18,000 tonnes of single resin and 25,000 tonnes of comingled waste plastics). This is sixteen times our current estimate of 2,700 tonnes of plastic used by manufacturers in B.C. The current demand for recycled resin in B.C. has significant growth potential.

To reach these levels, certain negative perceptions must be overcome by the end users. For example, a representative of Ford Canada stated that the public sentiment toward recycled plastic in new cars was synonymous with "second hand." Further, people buy new cars because they specifically want to avoid a "second hand" car.

These perception problems can be overcome in a number of ways. In the short term, in most applications there is no need to tell the consumer that recycled plastics have been

used. In the longer term, the general awareness and education of the public will rise to the point that they will demand recycled content.

We are already seeing evidence of the latter. Consumers are now demanding recycled content in paper. Grocery stores are trying to improve their market share by paying significantly more than virgin stocks for plastic grocery bags that have a 10% post-consumer recycled content. These trends will continue until the general population feels that environmental "problems" have been appropriately addressed and are well in control.

These trends bode well for the recycling industry in British Columbia. As the demand for recycled products increases so will the demand for baled plastic and pelletized resin. The increased demand will result in an initial increase in price paid for pelletized and baled product. The increased revenues should assist in the development of an improved infrastructure in the industry.

At the same time, the increased rate of return will make it more attractive to import product as it will be easier to offset transportation costs. It is therefore important to foster the growth of an efficient recycling industry in British Columbia. We can then be a net exporter of recycled resins and products with recycled content.

VIII

Policy Recommendations

A. Policy should focus on the collection infrastructure and processing levels of the industry

Although the markets for recycled plastic resins are new and the economic viability of producing and marketing these resins is unproven, market potential for recycled single plastic resins is vast. Markets are developing quickly and more and more manufacturers are beginning to substitute recycled resins for their virgin counterparts. Lack of consistent supply of reprocessed resins is the primary impediment to increased use by manufacturers. In British Columbia, bottlenecks exist at both the collection and processing levels of the industry.

The collection infrastructure is not recovering sufficient waste plastic to support strong growth by processors. In addition, the vast majority of post-consumer plastic waste recovered from MSW is unsorted. Because British Columbia's brokers do not find it economic to sort plastic waste by resin type, most post-consumer waste recovered from MSW is suitable only for export to Asia where labour costs are low.

Market potential for comingled plastic resins also appears large. However, these markets are also unproven, as is the economic viability of producing and marketing comingled resins in the form of plastic wood. While British Columbia's waste plastics collection infrastructure is well geared to feed operations of this type, comingled resin processing is less attractive than single resin processing for several reasons:

- The economic viability of processors is less certain.
- Markets are less certain.
- Goods produced are of lower value (primary recycling is not possible).
- Plastic wood cannot itself be recycled, and must eventually be disposed.

For these reasons, policy should focus on stimulating the growth of a collection infrastructure that source separates plastic wastes and encourages the development of single resin reprocessing. Our specific recommendations are provided below.

B. The collection infrastructure needs to expand and change

The Ministry of Environment can influence the efficiency of the waste plastics collection infrastructure both directly and indirectly. In the following paragraphs we make specific recommendations related to four elements of the infrastructure.

1. Curbside pickup

Curbside pickup is the responsibility of municipal and regional government. However, the Ministry of Environment should:

- Encourage the extension of curbside pickup to new communities. Actions that could be taken include preparing publications and seminars designed to help municipalities assess the feasibility of implementing curbside pickup of recyclables, and the preparing of "How-to Begin" publications and seminars for use in communities where blue box is considered feasible.

- Encourage the extension of curbside pickup to include a wider variety of plastics. Offering municipalities assistance with consumer education to improve sorting and identification of waste plastics, as well as financial assistance with upgrading or modifying collection equipment could encourage program expansion.

- Encourage those communities not now collecting waste plastics to begin doing so. Assistance with consumer education and upgrading of the collection infrastructure would help achieve this goal.

- Educate consumers, to increase participation rates and reduce contamination. Publications describing the benefits of waste plastic recycling, containing detailed descriptions of how to identify various recyclable plastic resins, and how to properly clean and prepare plastic containers for recycling, could be distributed to blue-box participants by municipalities, and could be made available at drop-off depots.

2. Drop-off depots

The Ministry of Environment should:

- Encourage the establishment of drop-off depots in communities where curbside pickup of plastics is not feasible.

- Offer low interest loans for the purchase of balers.

3. Buy-back depots

The Ministry of Environment should include milk and fruit juice beverage containers in the proposed deposit/refund legislation. It is generally recognized that the deposit legislation is the most effective means of achieving high recovery rates. A consistent supply of clean HDPE bottles could substantially improve the viability of existing single resin processors.

4. Material sorting facilities

The Ministry of Environment should encourage the establishment of MSFs in British Columbia. This would stimulate the growth of the waste plastics processing industry and reduce the amount of comingled waste plastic that is exported.

- Consider offering low interest loans for the establishment of MSFs, if conventional sources of financing are unavailable.

C. Policy supporting the waste plastics reprocessing industry should focus on processors

Changes and/or expansion at all levels of the reprocessing industry will be needed if waste plastics recovered from British Columbia's MSW are to be processed and recycled in the province.

1. Brokers

- Encourage brokers to sort waste plastics, rather than exporting comingled waste. Low interest loans for the establishment of MSFs could help achieve this goal. A provincial levy on comingled waste plastic exports might also help to achieve this goal.

2. Processors

- Encourage expansion of single resin processing capacity in the province, once a sufficient supply of clean, separated waste plastic is assured.

- Consider supporting the establishment of comingled plastics processors in those regions of the province that cannot support the building of an MSF, if sufficient supply of plastic waste is assured, if the economic viability of the particular project can be demonstrated with some assurance, and if transportation economics preclude hauling waste to a distant MSF.

3. Manufacturers

Plastic product manufacturers appear prepared to incorporate more recycled resins in plastic products, once a consistent supply of recycled pellet is available from processors. Policy encouragement does not appear necessary. However, the Ministry of Environment could work with plastic products manufacturers to improve the recyclability of plastic products made with virgin materials, or a combination of virgin and recycled materials. The Ministry should:

- Encourage or legislate the coding of plastic containers to identify resins.
- Encourage the industry to reduce the number of plastics used in its products.
- Encourage the industry to phase out the use of metal in plastic containers.
- Encourage the industry to develop reusable plastic containers.
- Encourage or legislate the use of water soluble inks or recyclable plastic sleeves rather than paper labels. (This will save the capital and operating costs associated with removing paper labels and adhesives, which industry participants report represent $22 per tonne when recycling milk jugs, for example.)
- Encourage industry stewardship, in which companies take voluntary responsibility for the waste management of products they make.

D. Policies affecting markets

Although market potential for recycled plastic resins appears strong, markets are still in their infancy. The Ministry of Environment can help stimulate market growth in several ways:

- Develop purchasing policies that promote the use of plastic products with recycled content. In the immediate term, the provincial government can take a leadership role by developing purchasing policies that support the plastics recycling industry. Guidelines should be established that set out a minimum requirement for post-consumer content for all frequently purchased plastic products where recycled options exist.
- Promote public education and awareness of the benefits of purchasing plastic products with recycled content. Some plastics products manufacturers believe that consumers react negatively to products with recycled content. If this is true, a public education program could boost

the popularity of recycled products. Co-operative advertising with industry, widely-distributed publications, and educational tools for schools are all means of promoting public education and awareness.

- Promote research and development. The Government of British Columbia can assist industry with research and development directives aimed at developing new products from recycled plastics, or increasing the use of recycled resin in the manufacture of recycled products. This could be achieved by: providing research grants to industry, increasing funding to universities for plastics research, and improving tax incentives available to companies undertaking research.

E. Other

1. Opportunities for regional co-ordination

Given that waste supply is key to the successfully establishment of processors, a regional approach to project evaluations should be taken. Our research indicates that a processor needs a minimum of 4,000 to 5,000 tonnes of waste plastic input to be viable. If a processor is about to be established across a nearby border, the Ministry needs to know when making policy or financial assistance decisions. The Ministry should:

- Establish a formal and regular communication with counterparts in Washington state and Alberta.

- Consult with these jurisdictions when establishing policy and evaluating proposals.

2. Municipal solid waste marketing

Municipalities need to be better educated about the market value of recyclable wastes. Our research indicates that contracts with waste haulers and brokers vary substantially from one municipality to another, and that many could do better. If an MSF is established, surrounding municipalities will likely guarantee supply to it, alleviating this problem. In the meantime, and in other areas of the province, the Ministry should:

- Develop an education program to improve municipalities' understanding of solid waste markets.

3. Alternatives to reprocessing

In addition to encouraging the development of the reprocessing industry in British Columbia, the Ministry should:

- Encourage consumers to reduce consumption of disposable plastic packaging and to use refillable or recyclable containers or packaging whenever possible.

- Encourage industry to develop reusable containers.

- Encourage users of plastic packaging to consider switching to reusable containers. (In the North Eastern United States a new program ensures that milk jugs are reused 50 to 70 times before recycling.)

- Encourage industry to take cradle-to-grave responsibility for the packaging it uses.

Bibliography

City of Seattle, Department of Engineering, Solid Waste Utility. **1988-1989 Waste Stream Composition Study Final Report.** June, 1989.

Matrix Management Group; R.W. Beck and Associates; and Resource Conservation Consultants. **Best Management Practices Analysis for Solid Waste.** 1987 Recycling and Waste Stream Survey (Volume I). Publication No. 88-33A. Prepared for the Washington State Department of Ecology, December, 1988.

Ministry of International Business and Immigration. **Plastics Manufacturing in British Columbia**. Prepared by the Business Immigration Branch. January, 1991.

Peat Marwick Stevenson & Kellogg and the Recycling Development Corporation for the author. **A Market Development Plan for Recyclable Materials in British Columbia** (Technical Report). Prepared for the Municipal Solid and Biomedical Waste Branch, Ministry of Environment, Province of British Columbia. April, 1990.

Plastics Recycling Foundation. **Plastic Recycling: From Vision to Reality**. 1990.

Resource Integration Systems. **Collection Method Profiles and Materials Recovery Facility Assessment.** Prepared for the Council of Solid Waste Solutions (CSWS). September, 1990.

Resource Integration Systems. **Current and Target Recovery Rates from Plastics Packaging in Oregon.** Prepared for the Oregon Department of Environmental Quality. October, 1990.

United States Congress, Office of Technology Assessment. **Facing America's Trash: What Next for Municipal Solid Waste.** Publication No. OTA-0-424. October, 1989.

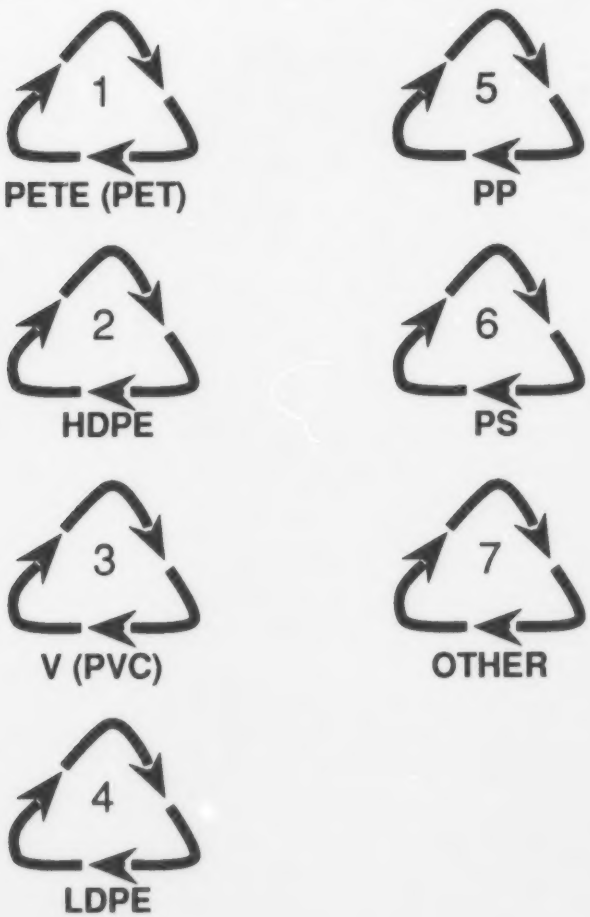
Washington State Department of Ecology. **1989 Washington State Recycling Survey**. Publication No. 90-69. 1989.

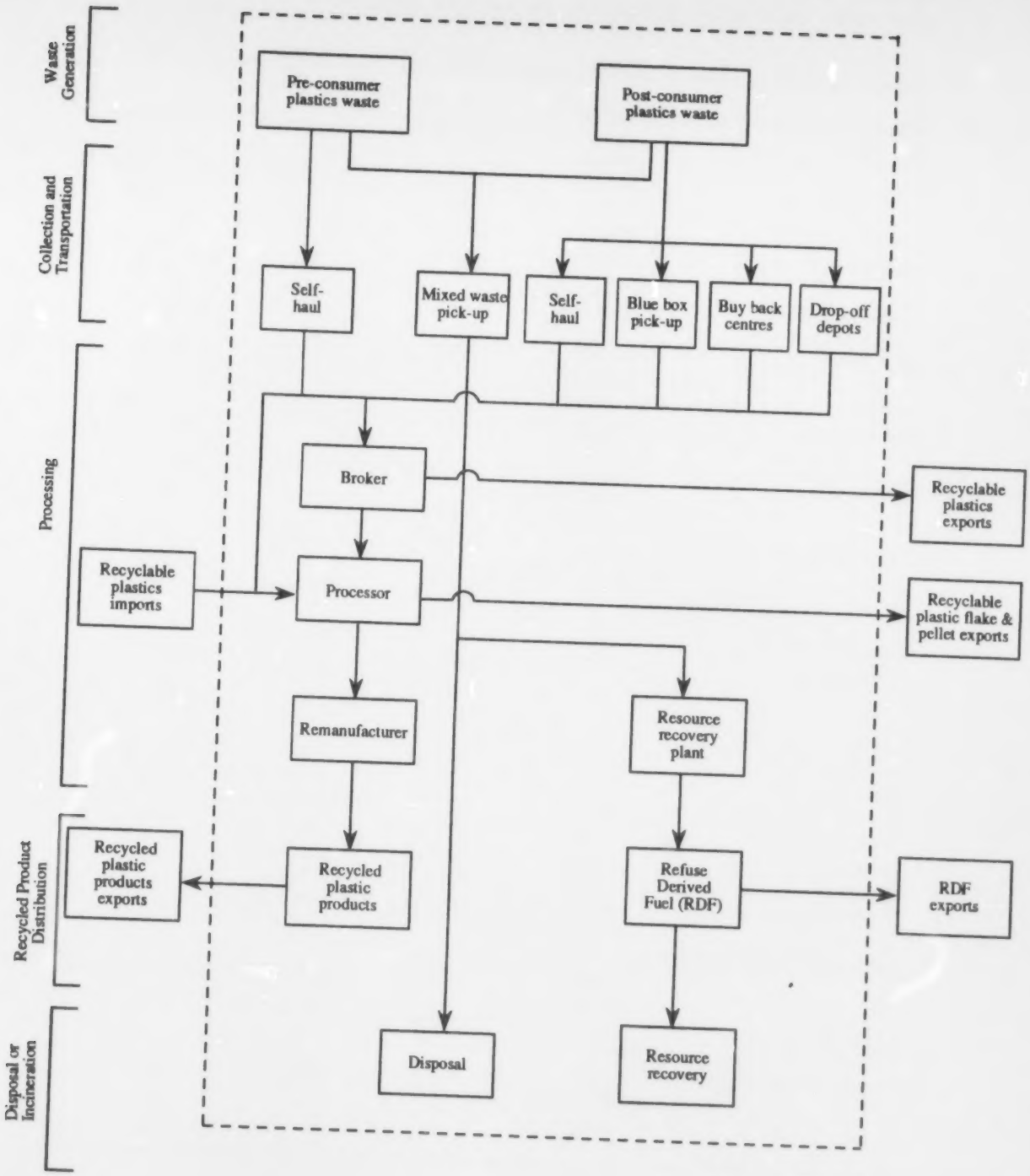
Appendix E

Plastic Resin Codes

Appendix E

Plastic Resin Codes





Note: Dotted line denotes boundary of activity within British Columbia.

Exhibit V-1
Curbside collection programs in British Columbia

	Paper	Glass	Metals	Plastics
Greater Vancouver Regional District				
Burnaby	news mixed	all clrs	tin/alum	HDPE PET
Coquitlam	news	all clrs	tin/alum	HDPE PET
Delta	news	all clrs	tin/alum	
Langley (Twnsp)	news	all clrs	tin/alum	HDPE PET
Maple Ridge/ Pitt Meadows	news	all clrs	tin/alum	
New West	news mixed milk crtn	grn/clr	tin/alum	
North Shore	news	all clrs	tin/alum	HDPE PET
Port Moody	news mixed milk crtn	all clrs	tin/alum	HDPE LDPE PET
Richmond	news	all clrs	tin/alum	HDPE PET
Surrey	news	all clrs	tin/alum	HDPE PET
Vancouver	news	all clrs	tin/alum	Rigid
White Rock	news	all clrs	tin/alum	HDPE PET
Capital Regional District				
Equimalt	news	all clrs	tin/alum	
Oak Bay	news	all clrs	tin/alum	
Saanich	news	all clrs	tin/alum	
Saanich Pen.	news	all clrs	tin/alum	
Saltspring	news	all clrs	tin/alum	
Victoria	news	all clrs	tin/alum	
Western Communities	news	all clrs	tin/alum	
Regional District of Nanaimo				
	news	all clrs	tin/alum	
Other Programs				
City of Nanaimo	news/corr			
City of Kelowna (pilot)	mixed corrugated ledger	all clrs	tin/alum	

Source: Recycling Council of B.C.

Exhibit V-1
Major waste plastic processors in British Columbia

Organization	Location	Function(s)			Type of Waste Plastic Handled						
		Broker	Processor	Remanufacturer	HDPE	LDPE	PET	PP	PVC	PS	ABS
Environmental Tech. Ltd.	Richmond	√			√		√				
International Paper Industries	North Vancouver	√			√		√				
Riteway Distributors Inc.	Nanaimo	√			√	√	√	√	√		
Coca Cola Bottling Co.	Vancouver	√					√				
Gray Beverage Co.	Vancouver	√					√				
Columbia Bottle Co.	Vancouver	√					√				
Liquor Distribution Branch	Vancouver	√					√				
KC Recycling	Trail		√		√			√			
Metalex	Richmond		√					√			
Merlin Plastic Supply Inc.	Delta		√		√				√		√
Eco-Pac Industries	Delta		√		√						
Listo Products Ltd.	Surrey		√	√	√	√		√		√	
Ellehammer Industries Ld.	Surrey		√	√	√	√					
Flexpak International Corp.	Richmond		√	√							
Hilinex Packaging Inc.	Vancouver		√	√	√						
PCL Packaging Ltd.	Delta			√		√					
Plastco Manufacturing	Langley			√	√						
Premo Plastics	Victoria			√		√					
Ropak Capilano Ltd.	Delta			√	√						

Exhibit VI-1
Principal plastics and their uses

Plastic Type	Original Uses	Uses After Recycling
Polyethylene Terephthalate (PET)	Soft drink bottles	Plastic lumber Non-food containers Car parts Fibrefill Carpets
Polyethylene		
- Linear low density (LLDPE) and Low density (LDPE)	Agricultural film Shopping bags Grocery bags	Grocery bags
- High density (HDPE)	Food containers Extruded pipe Oil bottles Milk/juice bottles	Flower pots Pipe Trash cans Garden furniture Non-food containers Car mats
Polypropylene (PP)	Dairy product containers Battery casings	Pipes Crates Garden furniture
Polyvinyl Chloride (PVC)	House siding Pipes Surgical gloves	Flooring Mouldings Stair treads
Polystyrene (PS)	Fast food packaging Egg cartons Disposable plates/cups	Insulation Coat hangers Flower pots
Mixed plastics		Flower pots Plastic lumber

Source: Discussions with industry participants, February, 1990.

Exhibit VII-I
Illustration of potential curbside recovery volumes

	HDPE and PET only	HDPE, PET mixed rigid containers[1]	HDPE, PET mixed rigid containers and film[1]
Present collection rates per person served (kg/year).	0.65	1.06	1.66
Potential collection for 3,132,000 population (tonnes).	2,000	3,300	5,200
Maximum possible with particpation rate increased from 80% to 100% (tonnes).	2,500	4,100	6,500
Likely maximum—5-% (tonnes).	1300	2100	3200

[1] *Usual mix is 90% HDPE, 10% PET.*

Appendix A

Glossary Of Terms

Appendix A

Glossary Of Terms

Acrylonitrile-butadiene-styrene (ABS)—type of plastic used for such items as car bumpers, telephone bodies, and sporting goods.

Broker—firm that sorts, cleans and bales recyclable plastics for shipment to a secondary processing facility. This category of company does not alter the waste in any mechanical manner (e.g., shredding or melting).

Comingled recyclable plastics materials—recyclable plastic waste that has been source separated from other non-plastics waste but in which all the recyclable plastics are grouped together undifferentiated by type of plastic.

Comingled recyclable materials—waste that has been source separated from non-recyclable waste but in which all the recyclable materials are grouped together.

Commodity thermoplastics—plastics produced at low cost in high volumes that are suitable for recycling. These plastics can be repeatedly softened with heat and remolded without a significant reduction in performance. They represent over two-thirds of all plastic sales. One example is polystyrene (PS).

Consumer—a firm or individual that makes a decision to reuse, recycle or dispose of a plastic product or package that has reached the end of its useful life.

Engineering thermoplastics—high cost, low volume plastics used in the construction, transportation, and electronics industries. These plastics form only a small proportion of MSW. One example is PTFE or Teflon.

High density polyethylene (HDPE)—type of plastic used for items such as milk containers, detergent containers, and base cups for plastic soda bottles.

Industrial/commercial/institutional waste (ICI)—waste collected from non-residential sources.

Low density polyethylene (LDPE)—type of plastic used for items such as plastic bags.

Materials recovery facility (MRF)—dedicated facility that accepts and processes a broad range of source separated recyclable materials from curbside MSW programs.

Mixed waste—unsegregated waste of all material types (paper, metal, glass).

Multi-material plastics and laminations—combinations of different types of plastics or plastics and other materials such as paper and metal foil. These plastics are used primarily for food packaging because of their favourable properties, such as increased shelf life. These plastics are technically difficult to recycle except into mixed plastic products. One example is the aseptic drinking box (two layers of plastic, paper and foil).

Municipal solid waste (MSW)—wastes from any source that enter either the collection or disposal systems operated by municipalities or regional districts (this excludes wastes that are recycled on-site without entering the collection steam and any commercial/industrial wastes that are disposed at a private disposal facility).

Polyethylene terephthalate (PET)—type of plastic typically used to make plastic beverage containers.

Polypropylene (PP)—type of plastic typically for battery casings and dairy product containers.

Polystyrene (PS)—type of expanded foam plastic typically used for fast food packaging.

Polyvinyl chloride (PVC)—type of plastic typically used to make industrial tubing.

Post-consumer waste—waste that has been consumed by residential or commercial users.

Pre-consumer waste—waste that is generated as a by-product of the manufacturing process (pre-consumer waste figures quoted in the report excludes in-plant recycling).

Primary processor—firm that shreds, flakes or pelletizes waste plastics for shipment to a remanufacturer.

Primary recycling—remanufacturing of recyclable materials into new products of similar characteristics and value as the original product.

Producer—a manufacturer of virgin plastic resins.

Quaternary recycling—recovery of energy through the burying of waste materials.

Recyclable materials—waste materials that have the potential to be remanufactured into new products with recycled content. (This definition implies tht a readily available and economical collection and transportation is available to ship the materials to a remanufacturer.)

Recycling—the process by which materials otherwise destined for disposal are remanufactured into new products.

Remanufacturer—a firm that remanufactures recyclable plastics into end products with recycled content.

Residential waste—waste collected at curbside by municipal crews.

Reuse—the reuse of a product for its original or new purpose, rather than recycling or disposing of it (e.g., refilling a soda bottle).

Secondary processor—see remanufacturer.

Secondary recycling—remanufacturing of recyclable materials into new products of lower value than the original product.

Source separation—the process of separating recyclable materials from other post-consumer waste in preparation for collection and transportation to a recycling facility.

Tertiary recycling—recovery of the basic chemicals and fuels from waste materials.

Thermosets—plastics used for long-lived products such as furnishings and building insulation. These plastics are generally not recyclable because they cannot be softened and remolded, although they can be used as filler. This group represents about 20% of plastic sales. One example is polyurethane.

Tipping fee—monetary charge for use of a disposal facility, typically in dollars per metric tonne of waste disposed.

Transfer station—an intermediate facility where collected waste is deposited for transfer to its final disposal site.

User—a firm that buys plastic and uses it to construct products, equipment or facilities, generating plastic waste off-cuts in the process.

Waste generation—the amount of plastics waste generated in the waste stream before recycling or disposal.

Waste recovery—the diversion of recyclable plastics from landfill or incineration.